Vol. 3 MAY, 1922 No. 2

SCIENCE LIBRARY

MAY 11 1922

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

CONTENTS

PAGE

The White-tailed Deer of Eastern United States, *Thomas Barbour and Glover M. Allen* 65

Longevity in Peromyscus ..... *F. B. Sumner* 79

The Prong-horn ..... *M. P. Skinner* 82

On the "Habitus" and "Heritage" of Cænolestes ..... *William K. Gregory* 106

General Notes 115

Another Opossum Taken in Vermont, *G. L. Kirk;* Some Habits of the Prairie Mole, *H. H. T. Jackson;* A Bat New for California, *D. R. Dickey;* A Correction, *H. H. T. Jackson;* A Brown Rat Kills a Rattler, *C. Hartman;* Woodland Jumping Mouse Near Tuxedo, New York, *J. P. Chapin;* Wanted—Data on the Red Squirrel, *A. B. Klugh;* The Correct Name of the West African Pygmy Squirrel, *H. Lang;* Magpie as Sentinel for Rabbits, *E. T. Seton;* Death of Charles B. Cory, *W. H. Osgood.*

Recent Literature 120

Correspondence 124

Fourth Annual Meeting in New York 125

PUBLISHED AT
MOUNT ROYAL AND GUILFORD AVENUES
BALTIMORE, MARYLAND

WILLIAMS & WILKINS COMPANY
BALTIMORE, U. S. A.

Entered as second-class matter, November 22, 1919, at the Postoffice, Baltimore, Md., under the Act of March 3, 1879.

Made in United States of America

The American Society of Mammalogists

Founded April 3, 1919
Incorporated April 29, 1920

E. W. Nelson, *President*
Wilfred H. Osgood; Gerrit S. Miller, Jr., *Vice-Presidents*
H. H. Lane, *Recording Secretary*
Hartley H. T. Jackson, *Corresponding Secretary*
Arthur J. Poole, *Treasurer*
N. Hollister, *Editor*

Additional Directors

1920–1922	1921–1923
T. S. Palmer	Glover M. Allen
Rudolph M. Anderson	Witmer Stone
M. W. Lyon, Jr.	Joseph Grinnell
W. D. Matthew	John C. Merriam
Edward A. Preble	H. E. Anthony

Standing Committees

Publications: N. Hollister, *Chairman.* Gerrit S. Miller, Jr., Edward A. Preble, Hartley H. T. Jackson, William H. Cheesman.

Life Histories of Mammals: Chas. C. Adams, *Chairman.* Rudolph M. Anderson, Vernon Bailey, Harold C. Bryant, Lee R. Dice, Hartley H. T. Jackson, T. S. Palmer, Ernest Thompson Seton, Walter P. Taylor, Herbert Lang.

Study of Game Mammals: Charles Sheldon, *Chairman.* George Bird Grinnell, George Shiras, 3rd.

Anatomy and Phylogeny: Adolph H. Schultz, *Chairman.* John C. Merriam, H. H. Donaldson, W. K. Gregory, J. W. Gidley.

Bibliography: T. S. Palmer, *Chairman.* Wilfred H. Osgood, Hartley H. T. Jackson.

Conservation: Wilfred H. Osgood, *Chairman.* E. W. Nelson, Jonathan Dwight.

Marine Mammals: E. W. Nelson, *Chairman.* Gerrit S. Miller, Jr., T. S. Palmer, Barton W. Evermann, Robert Cushman Murphy.

Economic Mammalogy: A. K. Fisher, *Chairman.* W. B. Bell, Harold C. Bryant.

The Journal of Mammalogy

Subscription rates, $3.50 per year; single numbers $1.00 each. Sent free to all members of the American Society of Mammalogists not in arrears for dues.

Manuscripts for publication, books and papers for notice and review, etc., should be sent to the Editor, N. Hollister, National Zoological Park, Washington, D. C.

Subscriptions, changes of addresses, requests for missing numbers, applications for advertising rates, etc., should be sent to the Corresponding Secretary, Dr. Hartley H. T. Jackson, Biological Survey, Washington, D. C.

JOURNAL OF MAMMALOGY

Published Quarterly by the American Society of Mammalogists

VOL. 3 MAY, 1922 No. 2

THE WHITE-TAILED DEER OF EASTERN UNITED STATES

BY THOMAS BARBOUR AND GLOVER M. ALLEN

[*Plates 4–5*]

Naturalists and sportsmen long ago remarked the large size of adult white-tailed deer of New England as contrasted with the appearance of deer from the South Atlantic States. Baird (1857) compared specimens from New York with those from Virginia and South Carolina, pointing out that the latter seemed to average smaller. Following him, Dr. J. A. Allen (1871) briefly remarked the same contrast between the deer of the northeastern states and those of Florida. Cory (1896) in his Hunting and Fishing in Florida devotes a brief chapter to deer, and makes the more definite statement that "the Florida Deer is smaller and varies slightly in color from the true *C. virginianus*. A full-grown buck will often not weigh over 110 pounds, although I have killed them considerably larger, and probably they occasionally (though rarely) approach in size their Northern relation." Dr. C. Hart Merriam in his Mammals of the Adirondacks (1884, p. 4) says, "Our deer are much larger than those of the South and Southwest, adult well-conditioned bucks averaging from 200 to 225 lbs. avoirdupois in weight, and exceptionally large ones being much heavier. Hence the Adirondack Deer is more than double the size and weight of the same species in Florida." In a brief and unsigned review of Cory's book, Dr. Elliott Coues (in The Nation, vol. 62, p. 404, 1896) emphasizes the difference in size between the northern representatives of certain species and those occurring in Florida, and casually proposes two new names, one for the Florida red bat (*Atalapha borealis peninsularis*) and one for the Florida deer (*Cariacus fraterculus*). Both names are *nomina nuda* and furthermore the two forms in question had been described and

named shortly before, the bat by Rhoads, the deer in a preliminary paper by Mr. Outram Bangs (1896) who at that time was energetically investigating the mammalian fauna of Florida preparatory to the publication (in 1898) of his summary of the species known from the state. In naming the Florida deer *Cariacus osceola*, he unfortunately lacked specimens of typical *virginianus* for comparison, but contrasted the deer of northern Florida with the large deer of Maine which at that time was believed identical with typical *virginianus*, but was later named by Miller (1900) as a distinct race, *borealis* (type from Bucksport, Maine).

Although it was originally thought that the Florida deer differed so markedly from typical *virginianus* as to constitute even a distinct species, the gradual accumulation of additional facts and specimens in the intervening years has shown that the supposed sharp distinctions were after all of only relative value, until it became finally a question whether or not the deer of Florida were really distinct from true *virginianus* with which as yet it had not been carefully compared.

With these facts in mind one of us (Barbour) has spent no little time and effort during the course of several visits to Florida, in gathering notes and material, particularly skulls, that might throw light on the relationships of the white-tailed deer of the peninsula. Such great changes are now taking place in the way of clearing large areas of woodland, building railroads, and constructing drainage canals in Florida that the distribution and abundance of so large an animal as the white-tailed deer cannot but be changed very considerably within a few decades. The importance of obtaining adequate material to illustrate its present distribution is, therefore, obvious.

In the course of our work it at once became clear that an adequate idea of the characters of typical *virginianus* was essential, and this made necessary a re-examination of the status of the northern race *borealis*. Of Florida specimens, in addition to three of the original four representing Bangs's *osceola*, the Museum of Comparative Zoölogy now has a series of skulls from Cumberland Island, Georgia, a series from the vicinity of Palm Beach, Florida, and a third lot from Chokoloskee in extreme southwestern Florida, as well as a few from other localities in northern Florida and three others from Big Pine Key, some 130 miles south of Miami. Years ago by permission of the New York authorities Barbour was able to obtain specimens in summer coat from the Adirondacks, which with the type and other specimens in the Museum of Comparative Zoölogy fairly represent the northern race *borealis*.

Thanks are due the U. S. National Museum and the Biological Survey for the loan of skins and skulls to supplement the few in the Museum representing typical *virginianus*; also to Maj. Allan Brooks for additional notes and sketches from Florida.

The material now before us, though still inadequate, embraces a fairly considerable series of skulls from eastern North America, together with skins representing winter and summer pelages of both sexes. A study of these specimens seems to indicate that occasionally deer may attain as large a size in northern and east-central Florida as in Virginia or Maine and that there is no natural discontinuity in the general distribution of the species from north to south on the mainland. The northernmost deer have been considered as representing a large subspecies with longer tooth rows and bigger antlers, but in dimensions adult Maine skulls can be matched by those from Palm Beach, Florida. It is further apparent that the northern race *borealis* (type locality Bucksport, Maine) is at best a poorly marked subspecies characterized perhaps by its more widely spreading antlers, much longer winter coat, and slightly brighter color in summer. The deer of the extreme southern tip of Florida on the other hand is very small indeed, with a small skull and small delicate antlers, yet with a tooth row very little reduced in absolute size from that found in typical *virginianus*. To this we propose to restrict the name *osceola*, considering the type, and other specimens from Citrus County, to be extreme intergrades, and standing really nearer to true *virginianus* than to the small deer from the tip of the peninsula. Finally, we are describing as a very distinct geographic race the small pallid deer with reduced tooth row that inhabits the southernmost keys of Florida. These four races of the eastern United States may be characterized as follows:

Odocoileus virginianus virginianus (Zimmermann)

VIRGINIA DEER

Dama virginiana Zimm., Specimen Zoologicae Geographicae, p. 351, 1777.

Type.—Based on Pennant's Synopsis, 1771, p. 51, pl. 9, fig. 2 (antlers).

Type locality.—None specified beyond "America," though assumed to be Virginia; but the references are to Lawson's and Catesby's works on Carolina.

Diagnosis.—Adults nearly or quite equalling in size the race *borealis*. Color of summer and winter pelages markedly different; in summer the coat is bright, nearly uniform ochraceous buff on dorsal surfaces of neck, body and legs; in the winter pelage the hairs of the back are black-tipped with a narrow subterminal band of pale ochraceous giving a much darker, ticked appearance. Upper cheek teeth 73–81 mm.

Description.—A *fawn* (2395 M. C. Z., from Citronelle, Florida, August 4, 1894) is nearly uniform "ochraceous buff" on the head and body above, paling to "warm buff" on the limbs and sides of neck and body; body spotted with white in a definite pattern: a line of spots on each side of spine from occiput to root of tail, succeeded by four or five less regular broken lines of spots on the sides from fore shoulder to haunch. Black bases of long hairs of tail showing through at the edges.

An adult male *in summer* (108038 U. S. Biol. Surv., July 17, 1894, Citronelle, Florida, taken as representing the extreme southern *virginianus*) has the forehead, neck all around, body and limbs above ochraceous buff, slightly warmer on forelegs, the center of back slightly darkened by showing through of a dark brownish band occupying about the middle third of each hair; sides and tip of tail above blackish with white fringe of long hairs from under side; ears dusky.

Adult *in winter* much darker, the crown, neck all around, and the body, a finely grizzled mixture of pale ochraceous buff and dusky—nearly "sepia,"—each hair with a fine blackish tip, a narrow subterminal ring of pale ochraceous and then a long dusky portion, paling out toward the base. Short hair on cheeks and muzzle similar but the pale band nearly grayish. Younger animals have the ochraceous buff less intense. A female from South Carolina, probably a yearling, has the pale annulus nearly "light buff", clearer on the legs but on the body much subordinated, producing a very dusky appearance with a clear dusky median stripe extending over the upper surface of the back and tail.

Skull.—Adult skulls equal in size those of average *borealis*, nor are the tooth rows inferior in length. The antlers of the average adult male have, as is well known, an inner tine a short distance above the burr, and three others on the upper side of the beam, the most proximal of which is usually the longest. Occasional especially vigorous adults have additional tines which may be irregularly developed. The basal portion of the antler from the burr to the first tine is on the average set at only a slight angle to the long axis of the skull, so that the line from burr to tip of basal tine tends to be more or less parallel to that axis and results in giving the tips of the beams in adults a tendency to approximate each other more or less closely. Nevertheless, this is not invariable, and occasional heads of southern deer have the antlers depressed and as wide-spreading as those in the North.

Weight.—Reliable weight-records for typical Virginia deer are not readily available. Cory (1912, p. 62) writing of the deer in Florida, states that though full-grown bucks often weigh not over 110 pounds, "these, however. are smaller than the average, and I have killed at least one specimen in southern Florida which weighed more than 200 pounds. . . . . For many years I carried steelyards with me in the field for the purpose of weighing large game. One buck weighed 204 pounds and during a dozen years I have killed others which . . . . were fully as large." A hunter who has killed many deer in Volusia County, Florida, assures us that the deer in Palm Beach County, to the south, where he has hunted of late years, average some thirty pounds less, indicating probably a gradual diminution in bulk as one proceeds southward.

Remarks.—Some difficulty has been experienced in determining the color characters of the typical Virginia deer, for lack of summer skins from near the type locality. While the limited material at hand seems to indicate that the

northern deer are slightly more tawny in summer without the darkening of black-ticked hair on the back, it may prove on examination of larger series that the difference is less than supposed.

In regard to the use of the specific name *virginianus* of Zimmermann instead of *americanus* credited to Erxleben (1777), it seems perfectly clear that the latter did not intend his adjectival use of *americanus* as a new name; nor does it occur in the same typographical form as the new names proposed in the same work (see J. A. Allen, 1900, p. 318; 1902, pp. 15, 18; W. H. Osgood, 1902, p. 87; O. Thomas, 1913, p. 585, footnote). Pennant, in his brief account of the "Virginian Deer," (the basis of Zimmermann's name) refers to Lawson's and Catesby's accounts of the natural history of the Carolinas, and quotes Ray's *Dama virginiana*, which no doubt was adopted by Zimmermann in turn. His figure of the antlers is unmistakable, though portions of his text seem to refer rather to the caribou.

Specimens examined:

MARYLAND: Cumberland, 3 (skulls).

VIRGINIA: No locality, 1 (skull); Appomattox River, 1 (skull); Claremont, 1 (skull); Highland County, 1 (skull); Hot Springs, 1 (skull); Richmond, 1 (skull); Rowleysburg, 1 (skull); Winchester, 1 (skull).

WEST VIRGINIA: Meadow Creek Mountain, 1 (skull).

NORTH CAROLINA: Halifax, 1 (skull); Halifax County, 1 (skull).

SOUTH CAROLINA: Colleton County, 2 (skulls); Georgetown, 1 (skin); Green Pond, 1 (skull).

GEORGIA: Cumberland Island, 7 (skulls).

ALABAMA: Mount Vernon Barracks, 1 (skull); Orange Beach, 1 (skull); Tensaw River, 1 (skull).

FLORIDA: Eastern Florida, 1 (skull); Big Cypress 25 miles southeast of Lake Trafford, 1 (skull); Brevard County, Kissimmee Prairie, 3 (skulls); New Smyrna, 1 (skull); Palm Beach et vic., 6 (skulls, one with headskin) and 3 pairs of antlers with frontlets; Sebastian, 1 (skull).

KENTUCKY: Big Bone Lick, shed antler.

Odocoileus virginianus borealis Miller

NORTHERN VIRGINIA DEER

Odocoileus americanus borealis MILLER, Bull. N. Y. State Mus., vol. 28, p. 83, October, 1900.

Type.—Adult male, skin and skull, 4999 Mus. Comp. Zoöl. (Bangs Coll.), from Bucksport, Maine, December 12, 1895.

Diagnosis: Similar to typical *virginianus* but summer pelage redder, the feet usually with conspicuous fringe of white hair between the toes; size on the average a very little larger; antlers usually coming off from forehead at a greater angle giving a slightly flatter spread, with less tendency for the tips of the beams to converge. Upper cheek teeth average 83 mm.

Color.—A *fawn* in full spotted coat (14913 M. C. Z. from Tupper Lake, Adirondacks, New York, August 25) is clear "tawny" on the upper neck, back and dorsal surface of tail, paling to a light "cinnamon" on ventral surface of neck, on the limbs and lateral line; ears mixed grayish externally. It is much more

tawny than a perfectly comparable *virginianus* fawn. The lines of white spots as in the typical race.

Adult *in summer*, (14921 M. C. Z., ♀, from Tupper Lake, New York, August 24) uniform tawny above from crown to tail without intermixture of dark-tipped hairs, paling at the sides, on limbs and front of neck to cinnamon; sides of muzzle pale grayish, the backs of the ears and a median line on the muzzle dusky. A conspicuous fringe of white hair between the toes of both fore and hind feet.

Adult *in winter* (4999, type, ♂, from Bucksport, Maine, December 12) identical with typical *virginianus* in corresponding season, but with the pelage longer than in deer from the extreme south of its range, and with a conspicuous fringe of white hair between the toes.

Skull.—We have been unable to discover any characters that will uniformly separate skulls of northern deer from those of Maryland, Virginia, Georgia, northern and central Florida. While skulls from the north tend to be large, they can be closely matched in the series from Palm Beach, Florida. In adult males, however, it is much more usual to find the basal portion of the antler coming off at a wider angle, so that not only does the basal tine often point in or form a wide angle with the main beam (instead of nearly continuing its basal axis) but as a result the beams are more spreading and seldom have their tips so closely approximated as in well developed heads of *virginianus*. The skull of the type of *borealis* is unusually large and the antlers more spreading than in the average deer from the North.

Measurements.—See table (p. 76).

Remarks.—In the brief diagnosis of this northern race (Miller, 1900) true *virginianus* is distinguished by its relatively small teeth ("lower row of cheek teeth 75" mm.) and by having the "winter pelage not conspicuously grayer or coarser than summer pelage;" whereas *borealis* has relatively large teeth ("lower row of cheek teeth 85" mm.) and the winter pelage is "coarse, usually much tinged with gray, very different from summer pelage." The material now available shows that these criteria do not all hold good.

Phillips (1920, p. 132) has lately shown that in 95 adult males from Maine the lower tooth row averages 83 mm. with extremes from 71 to 92. In an adult male from Winchester, Virginia, before us, the lower tooth row is 88, in two others from Virginia, 77 and 81 respectively, and in five adult males from Palm Beach, Florida, 78, 80, 85, 86, 87 respectively. There is probably a very slight average difference between extremes of the two races, but it is hardly diagnostic. As to the supposed lack of a seasonal change in color in the case of the southern deer, it is difficult to see on what ground the supposition rested. For while the adult in summer from northern Florida may not be quite as clear or bright a tawny as an Adirondack deer "in the red" it is quite as obviously different in its close ochraceous pelage of this season from the longer, more mixed "blue" or "gray" of its winter coat. So far as the scant material at hand indicates there is no color difference in winter coats of *virginianus* and *borealis*, except that in Florida one never sees a deer with such a long, shaggy "gray" coat as is assumed, for instance, by Adirondack deer in mid-winter; but the summer coat of the latter in both fawn and adult is apparently a trifle brighter, a clear tawny rather than ochraceous-buff with dark ticking, though how far this will hold true in a larger series is not yet certain. Another striking difference between the northern skins and

the southern ones available for comparison is that the former have a conspicuous white fringe between the toes, lacking in most southern specimens.

Where *borealis* intergrades with *virginianus* and where the southern border of its range may be traced are still matters for further investigation. Probably in the range of *borealis* should be included all of New England and at least northern New York, west to Ontario, northern Wisconsin and Minnesota (Cory, 1912). Whether the deer originally indigenous to southern Connecticut and those of southern New York (Long Island) are better referred to *virginianus* we are not prepared to say. Rhoads considers the larger deer of Pennsylvania *borealis*. Skulls from Maryland, Virginia, West Virginia, the Carolinas, Georgia, Alabama, and northern and east-central Florida are certainly to be considered typical of *virginianus*. The westward limits of both forms and the exact status of the races *macrourus* and *louisianæ* are still matters requiring further study.

Weight.—Large deer in winter coat will generally weigh over 200 lbs., and exceptional individuals considerably exceed this.

Specimens examined.—

MASSACHUSETTS: Lee, 1 (skull).

MAINE: Locality indefinite, 3 (skulls); vicinity of Upton, 33 (skulls); Bucksport, 4 (2 skins and skulls including type).

NEW YORK: Big Tupper Lake, 11 (including 6 skins with skulls).

ONTARIO: 2 (skulls).

Odocoileus virginianus osceola (Bangs)

FLORIDA DEER

Cariacus osceola BANGS, Proc. Biol. Soc. Washington, vol. 10, p. 26, February, 1896.

Type.—A young adult female, skin and skull 2394 M. C. Z. (Bangs Coll.) from Citronelle, Citrus County, Florida, December 29, 1893.

Diagnosis.—In its extreme form, slightly smaller in cranial dimensions, but with tooth rows practically as long as in *virginianus*; general bulk of body considerably less, the antlers much reduced in size; upper cheek teeth 72–77 mm.

Remarks.—In describing the small deer of Florida as a distinct race, Mr. Bangs had unfortunately no specimens from the type locality of *virginianus* for comparison. Of his original series two, including the type, are females decidedly undersized, one of them indeed abnormal in wholly lacking the third upper molar on the right side while the corresponding one on the left side lacks the hypocone, so that the tooth is triangular in outline rather than quadrilateral. The two adult males of the series on the other hand, one from Citronelle, the other from Blitche's Ferry, Citrus County, are good-sized animals, fully as large as typical *virginianus* from farther north. Indeed, it would be perfectly fair to consider the entire series as representing *virginianus* and to make *osceola* a synonym of it. The series of skulls from Chokoloskee, in extreme southwestern Florida, however, indicates unquestionably a valid race in that part of the peninsula, characterized by its very much reduced antlers, slightly smaller skull, and light weight. For the present, therefore, it seems better to restrict the name *osceola* to these small deer of southern Florida, and to assume in lack of evidence to the contrary that

this form extends northward on the Gulf Coast, intergrading with true *virginianus* in the region of Citrus County and southeastward. Specimens from the type locality would therefore be intergrades, more nearly approaching *virginianus*.

In the six adult males from Chokoloskee, the finest head (pl. 5, fig. 5) has antlers with the beam only 375 mm. long on the outer curve, basal tines 23 mm. long (570 and 85 in a head from southern Maryland), and two additional tines on each beam. Another old animal has two very small points (one broken off) on the right beam, and none on the left. Both beams are thick, with heavy burring at base and directed nearly straight back. The other heads all show a very small delicate beam with basal tines small or in some cases absent entirely, and with at most two short tines additional (pl. 5, figs. 6, 7). Two heads are asymmetrical: one has a simple beam on the right side without tines, while that of the left side has two small prongs; the other head has no basal tines, but two points on the right and one on the left side.

The type of *osceola* is peculiar in having the ascending arm of the intermaxillary widely in contact with the outer tip of the nasal on each side. Almost always, whether in specimens from Florida or from farther north, these two bones are separated by an intervening strip of the maxillary, varying in width from 1 to 18 millimeters, so that the condition described is unquestionably abnormal. It is certainly not a character of any systematic importance as it was originally supposed to be.

Unfortunately no skins from extreme southern Florida are available, and since those from the type locality are quite as well referable to *virginianus*, it may be said that the color characters of this race in its extreme form are still imperfectly known. Hunters at Key West assure us that all the mainland deer undergo a seasonal change similar to that of the deer farther north.

We have seen no specimens from the region between Chokoloskee and Palm Beach, a distance of some 125 miles. The large deer of the latter region must be referred to typical *virginianus*. It may be assumed that the range of *osceola* is along the Gulf Coast to the western tip of Florida, avoiding the Everglades to the east and southeast, where no deer occur, a range similar to that of several other geographic forms.

In general the deer of east Florida are diminishing with alarming rapidity. The open country with scattered "hammocks" and almost invariably with myrtle or bay "heads" centering the hundreds of "prairie ponds" makes the deer the hunter's easy victim. The Florida deer are very strictly nocturnal, never moving about in daytime. They are hunted with slow-trailing dogs which do not give tongue, the hunter usually tying the dog to his belt. When a fresh track is picked out the dog simply leads its master to the thicket or "head" where the deer has chosen to spend the day. If the spot be a small palmetto thicket in the piney woods the deer is flushed at a few feet range and killed with buck-shot; if it has evidently "laid up" in a larger hammock or head the hunter puts in the dog on one side and hurries to the other side of the hammock, or if a group are hunting watchers are posted and the dog is loosed to drive out the deer. In cases where the deer escapes it will usually run an almost incredible distance and no further attempt is made to start it again. Until, however, the hunted deer is actually found by the dog, it lies perfectly still and I (Barbour) have often passed and repassed within ten feet of deer which were afterward started with a dog but which

had kept hidden regardless of my presence, smoking, and conversation. There is no question but that Florida deer winter in the "short blue" and never put on the "long blue" coat assumed by deer that winter in the snow.

Weight.—Cory (1896) says that a full-grown Florida deer "will often not weigh over 110 pounds" although he has killed them considerably larger. A writer in Forest and Stream (vol. 70, p. 245, 1908) reports one killed at Kissimmee, and thought to be unusually big, that weighed 135 lbs. without the entrails. Most of the Florida deer which Barbour has seen or heard of, killed about Hallandale, Miami or Homestead were rarely more than 120 lbs. after being dressed. A number of specimens seen in captivity in southeastern Florida were uniformly small.

Measurements.—See table (p. 76).

Specimens examined.—

FLORIDA: Monroe County, Chokoloskee, 6 adult ♂, 1 ♀ subadult (skulls); Polk County, Lake Arbuckle, ♀ yg., ? intermediate (skull); Citrus County, Citronelle, 4 (including type) and Blitche's Ferry, 1 (skins and skulls, regarded as intermediates closely approaching *virginianus*).

Between the mainland of southeastern Florida and the southern group of keys, there is a wide stretch of rather large, elongate islands, including Key Largo and the Metacumbe Keys, on which, at least within the memory of those now living, deer have never been found. Farther south still, however, in the "Lower Keys," there have been a few deer for a very long period. These were formerly known as "Spanish deer" because, apparently, it was recognized that they were unlike the deer of the mainland and it was, therefore, assumed that they had been brought by the Spaniards from Central America, as the Key West "conchs" well knew that dwarf white-tailed deer do occur on the coasts of Honduras and Nicaragua which they visit during their turtling expeditions.

These deer are much pursued and have become extremely wary, but a few are killed each year by hunters with dogs. After considerable effort Barbour finally succeeded in obtaining an adult male skull with scalp from Big Pine Key and a younger male in the second or third year. These, with a third young male shot by Mr. W. S. Brooks on the same key, seem unquestionably to represent a very distinct race, pale in color, small of body, and with reduced tooth rows. It may be named:

Odocoileus virginianus clavium subsp. nov.

KEY DEER

Type.—Adult male head-skin and skull, 19120 M. C. Z. from Big Pine Key, Florida, winter 1920 (said in Key West to be the record for size).

Diagnosis.—Smallest of the eastern races of Virginia deer, colors paler, teeth smaller than in the mainland races; upper cheek teeth 67 mm.

Description.—The type and two other immature males agree in the color of the head: in the former the crown and median dorsal line of the neck are "light buff" of Ridgway, darkened by the "bister" of the basal portions of the individual hairs; on the sides of the neck the bister pales out until on the cheeks and the sides and front of the neck, the color is "pale buff." A spot back of the nose and

on the under lip just ahead of the corner of the mouth are bister and the same color extends back from the muzzle to the fore part of the face, where, however, it is finely grizzled with whitish, as are also the backs of the ears. As usual, the spot behind the muzzle, the eye ring, inside and outer bases of the ears, and the upper throat are white. In other words the tawny hue is quite lacking. A similar difference characterizes the remainder of the winter pelage as shown in the two young male skins (both taken in March). The bister is not so deep, nor is the buff so bright ochraceous as in *virginianus*. The combined effect is to produce a very pale-looking animal very different from comparable specimens from the mainland (Palm Beach and South Carolina).

Skull.—Apart from the small size of the skull and antlers, this deer of the "Lower Keys" differs from all the mainland forms here treated in that the teeth are reduced in size, so that not only the length of the tooth row but also the individual teeth are obviously less than those of the other races, in which as already stated, the tooth row is of practically the same length in adults from Maine to southern Florida. All three of the specimens available agree closely in this respect and differ conspicuously from those of the mainland.

The antlers of the type, which according to local hunters, are of record size for Key deer, lack the basal or "crown" point on the right-hand side, but each has in addition two tines on the main beam. The length of the left antler, measured on the outer curve is 309 mm., of the crown point 42 mm.; proximal tine 90, distal tine 50. The tips of the antlers are 185 mm. apart.

Weight.—A full-sized doe is reliably stated to weigh approximately 65 pounds; the larger of the two immature males (No. 18497) was said to have weighed 80 pounds.

Measurements.—See table.

Remarks.—For additional information on the distribution and status of the Key deer we are indebted to Mr. Bascom L. Grooms, Manager of the Key West Electric Co., who has made particular inquiry on our behalf, especially of Mr. Henry Watkins, who has hunted on the keys for some 35 years. Two other hunters of long experience on the keys have corroborated his testimony.

These small deer are now strictly confined to the southernmost group of keys from Big Pine Key on the northeast to Boca Chica on the southwest, a small island some seven or eight miles from Key West. Big Pine Key has always been known as the chief refuge for the Key deer, and they swim back and forth from it to the smaller islands. From the testimony of Mr. Watkins, it appears that about thirty years ago deer were killed on Key West Island, but none has been seen there since. Deer were killed on Stock Island, a small key adjoining Key West, ten years ago (*circa* 1910) but none has since been known there. Proceeding northeastward, there were deer on Boca Chica until about the same time, when they disappeared, and were unknown there until late in 1920 when two were seen. They disappeared from Saddle Bunches Key about nine years ago (1912). They were also found on Sugar Loaf until the hurricane of 1910 when they disappeared, and none has been seen there since that time until the fall of 1920 when they were again reported from the island. Deer have always been found from time to time on Ramrod Key, all three of the Torch Keys, and probably Newfound Harbor. They swim readily from key to key and if hunted on the smaller islands they leave and go back to Big Pine Key. Later they will again appear on the smaller islands.

"It is safe to say that deer are likely to be found at any time on any key between Big Pine Key and Boca Chica and that they are more plentiful now than they were twelve to fifteen years ago. A good hunter was known to jump six deer in one day on Big Pine Key this last winter, (1920–21), when twelve to fifteen years ago it was not uncommon even with good dogs to be unable to jump a deer" there. On the three small keys just north of Big Pine, known respectively as Crawl, Grassy, and Duck Key, deer are said also to have been found, but none of the present-day hunters has ever been able to find deer on Long Key nor are they known to have inhabited keys to the northward.

The hunters believe that these deer have no special season for breeding and that their summer coat is not essentially different from that of winter. They inhabit the densest cover of thorns, bushes and palmettos and can only be successfully pursued with dogs to chase the quarry past the waiting hunter stationed at some favorable point. After they have been hunted for a few consecutive days they go into the extensive prickly-pear hammocks and remain there for some time, of course, safe from pursuit. This happened coincident with two visits when we were trying for specimens as a result of Cuban hunting parties from Key West.

To one unfamiliar with field conditions in Florida, the very marked faunal differences between the southern keys and those extending northeast to the nearest portions of the peninsula itself, are almost as striking as they are unexpected. These southernmost islands are very different in character from those of the chain running northeast from Big Pine, including Boot Key, Grassy Key, Metacumbe Key and the extended Key Largo. The last, at its northern end, approaches the mainland of the peninsula but is well separated from it by a deep channel through which flows a swift current. These northern keys in all probability have a somewhat different geologic history and origin from the more southern or "lower" keys. The difference in the character of the two groups and their possibly independent connection with the mainland is sufficient to account for the considerable difference in their flora and fauna. For a most interesting exposition of the peculiar environmental conditions obtaining in these islands the reader is referred to the chapter on "The Florida Keys" in Charles Torrey Simpson's delightful book "In Lower Florida Wilds" (1920).

Specimens examined.—

Florida, Big Pine Key, 3 (2 skins and skulls, and the type skull with head skin).

In the table following are given a few comparative skull measurements of the four races here considered. It would seem that after the exhaustive study made by Dr. J. C. Phillips (1920) these would be superfluous in the case of the race *borealis* but we have endeavored to select a few adults of each race, that appeared of maximum size and strictly comparable. This is of much importance for deer do not attain full size until they are several years old, so that cranial comparisons are often valueless unless the largest individuals of a series or those of quite comparable age are contrasted. For immature animals, however, it is possible to make accurate comparisons of several stages, of which we select three, namely: (I), skulls with three upper milk premolars and *first* permanent molar in place; (II) skulls with three milk premolars and *two* permanent molars in place; (III) skulls with three milk premolars and all *three* permanent molars in place. Deer

born in spring, are in stage I during the following fall, and by late spring have reached stage II. A deer with three milk molars and three permanent molars is usually at the beginning of the second fall, and before the third fall (2 yrs. old) has the complete dentition with "dag" antlers in the male.

Adult skulls

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	AUDITOBASAL LENGTH	ZYGOMATIC WIDTH	UPPER CHEEK TEETH	LOWER CHEEK TEETH
virginianus ..	101491 U. S. N. M.	Va., Bath Co.	♂	282	255	126	76	81
virginianus ..	105558 U. S. N. M.	Va., Winchester	♂	—	255	114	79	88
virginianus ..	18945 M. C. Z.	Fla., Palm Beach	♂	290	268	117	77	87
virginianus ..	18944 M. C. Z.	Fla., Palm Beach	♂	—	263	124	81	86
virginianus ..	17759 M. C. Z.	Fla., New Smyrna	♀	256	239	100	79	88
borealis.....	4999 M. C. Z.	Me., Bucksport	♂	311	283	132	80	82
borealis.....	1733 M. C. Z.	Me., Upton	♂	289	261	124	81	89
borealis.....	11458 M. C. Z.	N. Y., Tupper Lake	♀	258	233	102	73	77
borealis.....	18753 M. C. Z.	Ont., Long Point	♀	262	241	110	76	83
osceola.....	18596 M. C. Z.	Fla., Chokoloskee	♂	255	234	106	77	81
osceola.....	18301 M. C. Z.	Fla., Chokoloskee	♂	253	232	99	72	78
osceola.....	18597 M. C. Z.	Fla., Chokoloskee	♂	—	—	110	77	83
clavium.....	19120 M. C. Z.	Fla., Big Pine Key	♂	240*	215	106	67	73
clavium.....	18497 M. C. Z.	Fla., Big Pine Key	♂	195	181	89	62	70

I. Immature skulls, with dp $^{2-4}$ m^1

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	ZYGOMATIC WIDTH	CONDYLION TO p^2
virginianus ..	36971 U. S. N. M.	Va., Highland Co.	♂	195	86	135
virginianus ..	2384 U. S. N. M.	Va., Rowleysburg	♀		84	136
virginianus ..	122763 U. S. N. M.	So. Carolina	♀	199	85	132
borealis.....	1669 M. C. Z.	Me., Upton	♂	215	89	145
borealis.....	1675 M. C. Z.	Me., Upton	♀	226	95	154
?osceola.....	61849 U. S. N. M.	Fla., Polk Co.....	♀	194	80	130

II. Immature skulls, with dp^{2-4} m^{1-2}

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	ZYGOMATIC WIDTH	CONDYLION TO p^2
virginianus ..	111403 U. S. N. M.	Fla., Brevard Co.	♂	231	88	156
borealis.....	1695 M. C. Z.	Me.	♀	237	96	156
borealis.....	4221 M. C. Z.	Me., Bucksport	♂	235	99	160
clavium.....	18060 M. C. Z.	Fla., Big Pine Key	♂	191	83	131

III. Immature skulls, with $dp^{2-4}m^{1-3}$

NAME	NUMBER	LOCALITY	SEX	CONDYLOBASAL LENGTH	ZYGOMATIC WIDTH	CONDYLION TO p^2
virginianus ..	17558 U. S. N. M.	Va., Chesterfield	♀	—	96	156
borealis.....	83 M. C. Z.	(?) Maine	♀	244	108	166
osceola.....	18302 M. C. Z.	Fla., Chokoloskee	♀	221	87	151

REFERENCES

Allen, J. A. 1871. On the mammals and winter birds of East Florida, with an examination of certain assumed specific characters in birds, and a sketch of the bird-faunae of eastern North America. Bull. Mus. Comp. Zoöl., vol. 2, p. 161–450, 5 pls.

1900. Preliminary list of New York mammals. [Review of Miller, 1900.] Amer. Nat., vol. 34, p. 316–318.

1902. Zimmermann's "Zoologiae Geographicae" and "Geographische Geschichte" considered in their relation to mammalian nomenclature. Bull. Amer. Mus. Nat. Hist., vol. 16, p. 13–22.

Baird, S. F. 1857. Mammals. U. S. War Dept., Rept. Expl. and Surveys for a Railroad. . . . . to Pacific, vol. 8, pt. 1, p. xxi–xlviii, 1–757, pl. 1–60.

Bangs, Outram. 1896. The Florida Deer. Proc. Biol. Soc. Washington, vol. 10, p. 25–28.

1898. The land mammals of peninsular Florida and the coast region of Georgia. Proc. Boston Soc. Nat. Hist., vol. 28, p. 157–235.

Cory, C. B. 1896. Hunting and Fishing in Florida. sm. 4to, Boston, 302 pp., illustr.

1912. The mammals of Illinois and Wisconsin. Publ. Field Mus. Nat. Hist., Zool. Ser., vol. 11. 502 pp., illustr.

[Coues, Elliott.] 1896. Hunting and Fishing in Florida. By Charles B. Cory. [Review.] The Nation, vol. 62, p. 404–405.

MERRIAM, C. H. 1884. The vertebrates of the Adirondack region, northeastern New York. (Second instalment, concluding the Mammalia.) Trans. Linn. Soc. New York, vol. 2, p. 9–214.

MILLER, G. S., JR. 1900. Key to the land mammals of northeastern North America. Bull. N. Y. State Mus., vol. 8, p. 59–160.

OSGOOD, W. H. 1902. Some names of American Cervidæ. Proc. Biol. Soc. Washington, vol. 15, p. 87–88.

PHILLIPS, J. C. 1920. Skull measurements in the Northern Virginia Deer. Journ. Mammal., vol. 1, p. 130–133.

SIMPSON, C. T. 1920. In Lower Florida wilds. A naturalist's observations on the life, physical geography, and geology of the more tropical part of the State. 8vo, New York, xv + 404 pp., illustr.

THOMAS, OLDFIELD. 1913. On certain of the smaller S.-American Cervidæ. Ann. Mag. Nat. Hist., ser. 8, vol. 11, p. 585–589.

EXPLANATION OF PLATES

(All figures one-seventh natural size.)

PLATE 4

FIG. 1. Virginia Deer (*Odocoileus virginianus virginianus*), 38693 U. S. Nat. Mus., from Cumberland, Maryland. Adult male with large, normally developed antlers.

FIG. 2. Northern Virginia Deer (*Odocoileus virginianus borealis*), 13240 M. C. Z., from Oxford County, Maine. Adult male with average normal antlers, showing the tendency to spread at the tips.

PLATE 5

FIG. 3. Virginia Deer (*Odocoileus virginianus virginianus*), 19118 M. C. Z., from near Palm Beach, Florida. Adult male, with abnormally erect antlers, their tips nearly in contact.

FIG. 4. Key Deer (*Odocoileus virginianus clavium*), 19120 M. C. Z., type, from Big Pine Key, Florida. Said to be a very large head for this race.

FIG. 5. Florida Deer (*Odocoileus virginianus osceola*), 18597 M. C. Z., from Chokoloskee, Florida. Adult male, with large normal antlers.

FIG. 6. Same, 18596 M. C. Z., Chokoloskee, Florida, adult, with average normal antlers.

FIG. 7. Same, 18598 M. C. Z., Chokoloskee, Florida, adult. The antlers are asymmetrical in the number of points and lack the basal or "crown" tine.

Cambridge, Mass.

SKULLS OF WHITE-TAILED DEER

(Barbour and Allen: White-Tailed Deer.)

SKULLS OF WHITE-TAILED DEER

(Barbour and Allen: White-Tailed Deer.)

LONGEVITY IN PEROMYSCUS

By F. B. Sumner

Various writers have doubtless recorded observations bearing upon the longevity of rats and mice, but very few of these have come to my notice. No careful search for such records seems profitable, however, in connection with the publication of the following brief notes of my own. I shall therefore proceed without making any extensive display of references to "the literature," and shall ask the indulgence of those whose publications I have overlooked. It is worth mentioning that I find rather wide differences among the estimates which lie at hand. Weismann, in his well-known essay on "The Duration of Life" states that a "mouse" (presumably he means a house-mouse) lives six years, while the anonymous author of the booklet "Fancy Mice" assures us that, if properly cared for, mice "will live for two or three years, and then die of old age." The white rat, according to the extensive observations of Donaldson and his co-workers, is to be regarded as very old at the age of three years (i.e., comparable with a man of 90), while the female commonly becomes sterile at the age of 15 to 18 months.

With deer-mice, as in the case of most wild animals, there would seem to be no way of testing the natural span of life, except by rearing them in captivity, from birth until the time when they finally succumb to "old age." The period thus measured doubtless does not fairly represent the average life cycle in nature. On the one hand, the conditions of captivity, as I have more than once pointed out, do not make for normal development on the part of all individuals. Sterility, stunting and even deformity, may be the result of these artificial conditions. In the mouse's favor, on the other hand, is the fact that it is protected and fed throughout life, a circumstance which is of particular importance during the period of old age. Thus, several of the mice referred to below became extremely feeble many months before death occurred. Such animals would doubtless have died or been killed much earlier in a state of nature.

In September, 1916, ten mice (five of each sex) were selected from the first cage-bred generation of *Peromyscus maniculatus gambeli*, belonging to the local (La Jolla) strain. These mice were, at this time, about a year old. They were normal, healthy specimens, but not otherwise exceptional. Two of these animals met with an accidental death, when more than two years old; another met with a

presumably "natural" death at a date which was unfortunately not recorded. This mouse is known, however, to have reached an age of at least 3 years and 2 months.

The remaining seven individuals died at the following ages:

♀ 71	3 years,	0	months
♂ 20	3 "	4 (+)	"
♀ 11	4 "	2	"
♂ 39	4 "	5	"
♀ 81	4 "	8 (+)	"
♀ 2	5 "	3 (−)	"
♀ 22	5 "	8 (−)	"

Thus, five of these mice attained an age of more than four years, while two attained an age of more than five years. The patriarch (or rather, *matriarch*) among them reached the ripe age of 5 years and 8 months.

In all of these seven cases, death resulted from disease or "old age." Several of the mice became extremely senile and "wobbly" long before death occurred, and it was noted that several of them were very much affected by cold. Such individuals became numb and feeble on cold days, and it is perhaps significant that five of the deaths occurred during the winter or late fall.

No obvious changes occurred in the appearance of the senile pelages, though the two oldest of these have been saved for more careful study. It is worth noting that of the two which died in the sixth year one was dark and the other somewhat buff, representing the normal range of variation in adult individuals of this subspecies. It was noticed that one of the males, in middle or late life, acquired a curious "grizzled" appearance in the hair of the face, giving him a decidedly venerable appearance. I found, however, that this was a hereditary peculiarity of the family to which the grizzled mouse belonged. It was noted in at least four other individuals, in some cases while the animals were still young.

Unfortunately, my records, as regards the fertility of this "old age" stock, are very meagre. At the commencement of the experiment, all were mated, except one male, which was kept apart until he was nearly three years old, and then mated. No record was kept of the earlier broods resulting from these matings. It is probable that some of the individuals were sterile from the outset, a condition not infrequent among cage-bred *Peromyscus*.

My few positive results bearing on the duration of the reproductive period are as follows. One pair (♀ 2 and ♂ 21) produced a brood of five or six young, when at the age of 31 months. Two of these reached the age of 4 months and were then killed. The father met an accidental death not long after, and the mother was mated to ♂ 20, whose fertility was unknown. No further broods resulted.

Another pair (♀ 81 and ♂ 39) produced one brood at the age of 33 months, and another when more than 34 months old. They were remated about 5 months after the birth of this last brood, but no further young were produced, though these mice lived together for more than a year. The two broods referred to contained but two individuals each, and of these four only two reached the age of two weeks. From these facts and those mentioned in the preceding paragraph, it seems possible that the offspring of parents of this age tend to be weak. But such sickly broods may be born to parents at any time of life, and the results here cited may have no relation to the age of the parents.

Females 2 and 22, when nearly five years old, were mated to a fertile male of another lot, but no young resulted, as might have been confidently expected.

A record for two other mice of my stock is worth reporting here. The pair in question were wild ones, whose age, at the time of trapping, was of course unknown, though they were probably at least several months old at the time. Their last brood was born very nearly three years later.

The salient facts in the foregoing discussion seem to be that one mouse of the subspecies *Peromyscus maniculatus gambeli* is known to have reached the age of five years and eight months in captivity, while two pairs are known to have produced young when both parents were nearly or quite three years old.

Scripps Institution, La Jolla, Calif.

THE PRONG-HORN

By M. P. Skinner

[*Plates 6–9*]

The prong-horn is found only in North America, where it is one of the most characteristic animals. It is peculiar in that the horn sheath is shed every year, leaving the core, which is an integral part of the skull, in place; in that the horns have a prong, hence the name, prong-horn; in that the coarse hair is of very peculiar form and character; and in that all the hair of the rump, surrounding a musk gland, can be erected. It has wonderful eyesight; and is capable of great speed.

Family ANTILOCAPRIDAE. Prong-horn Antelopes

Closely allied to the Bovidæ, but the horns deciduous and branched (Flower and Lydekker).

Genus **Antilocapra** Ord

Antilocapra Ord, Journal de Physique, vol. 87, p. 149. 1818.
Type of genus.—Antilope americana Ord, 1815.

Dentition of genus. $\mathrm{I}\ \frac{0-0}{3-3}\ \mathrm{C}\ \frac{0-0}{1-1}\ \mathrm{P}\ \frac{3-3}{3-3}\ \mathrm{M}\ \frac{3-3}{3-3}\ 32.$

Characters of genus.—Bony horn cores unbranched, forming vertical, blade-like projections immediately above the orbits; horns compressed, about 250 mm. in length, in a straight line, or 400 mm. following the curves, having a gentle backward curvature, the short branch or prong arising about the middle of its height. When the horn is about to be cast off, it becomes loosened and a new one covered with long hairs, which soon disappear, is formed upon the bony core beneath it. The ears are long and pointed. Tail short and pointed, densely coated with coarse hair, except on the underside where the hairs are extremely short. The neck has a thick mane of long chestnut colored hair. Accessory hoofs are wanting. The lachrymal sinuses of the true antelopes are undeveloped; as also are the "inguinal pores," or groin sacks found in true antelopes.[1]

SUBSPECIES

Antilocapra americana americana (Ord), 1815. Described from the "plains and highlands of the Missouri," and including most of the range of the Prong-horn.

Antilocapra americana mexicana Merriam, 1901. Mexican Prong-horn Antelope. Described from Sierra en Media, State of Chihuahua, Mexico. Sonoran and Transition zones of northern Mexico, extending north into the United States, along the Mexican border.

---

[1] Mearns, Bull. 56, U. S. Nat. Mus., pp. 220–221, 1907.

Antilocapra americana peninsularis Nelson, 1912. Described from forty-five miles south of Calmalli, Lower California. This animal is probably confined to the peninsula of Lower California, Mexico.

Although this animal is known all through the west, and throughout American literature, as the antelope, we have no true antelopes in this country,[2] for all the existing animals of the group, including the gazelles, are Old World species and mainly of African habitat. This is the only animal in the United States that approaches them at all in form and habits. It is the sole representative of its genus and family, for the peculiarities of the horns and their growth are deemed sufficient to justify a separate family, intermediate between the giraffes and the Bovidæ. It is known generally as American Antelope, Prong-horn, or Prong-buck, and was called Cabree and Cabrit by the Canadian French trappers.

A full-grown prong-horn is smaller than most adult American deer. The bucks are slightly larger than the does. The robust and somewhat chunky body, which supports a short, thick-set neck carrying erect a large head, is quite different in form from that of a deer. The tail is very short, and the limbs are slim and rather short.

The coloring is made up of white and fawn, with black and brown markings about the head and neck. The white occupies all of the under surface of the body, extending down the inner side of the limbs and also well up on the sides of the body, where a rectangular area between the shoulder and hip is formed. The rump, with the exception of a narrow fawn strip usually connecting the upper surface of the tail with the colored area of the back, is white; and when erected in fright or excitement, it catches the sun and gleams out brightly. The lips and chin are white; in the mouth parts, the mucous membrane and naked areas are coal black. White also are areas on the cheeks, throat, and inner surface of the ears, besides which the neck, underneath, is beautifully marked with a white crescent above, and a white shield below. Fawn occupies the back and most of the neck, extending down the outer sides of the limbs until it encircles them low down, and also extending backward in a narrow line dividing the rump and terminating on the basal part of the tail. This fawn color becomes more tawny on the neck, and the elongated hairs of the short, erect mane are russet, tipped usually with black in varying amount. The head, which varies from creamy white on the sides to wood brown above, is marked with

[2] The Rocky Mountain goat is the nearest approach to the Old World "antelopes" among the American Bovidæ.

brownish black in the male. There are white areas around the horns and at the base of the ears. The blackish markings are much more noticeable on the old males than on the does and younger animals. In typical *americana* the black sometimes occupies the whole face below a line connecting the horns, but usually this area is T-shaped with the horizontal line between the horns and the vertical line down the nose. In *mexicana* and *peninsularis*, the blackish area becomes dark brown, and is more restricted. In all forms, the eyelashes are jet black. There is a black edge to the ear, and a black line, in the male, outlines the edge of the lower jaw, starting just below the ear and extending down for several inches, less on younger bucks than on older animals. This latter is a sex mark, distinguishing the male at all ages, and even appearing on some fetal specimens. The tail is white, or nearly so. The small pointed hoofs are double and black; the two small rudimentary hoofs, usually seen on ruminant animals on the rear legs above the genuine hoofs, are absent.[3]

The amounts of black, brown, and white differ in this animal according to season, sex, and age.

Young prong-horns, until a month or two old, are paler than their parents, and the rump patch is tinged with pale russet and is not distinct—but it is interesting to observe that the rump can be erected by a kid but a few hours old—indeed all of the pattern is obscure, the white areas are stained with dull buff, and the blackish parts are only faintly indicated. Little curls of dusky hair mark the location of the coming horns of the male.

A full-grown prong-horn is about four and a half feet long and between three and four feet high at the withers. A few weights are recorded by Mearns: an adult male weighed 112 pounds as killed, after bleeding; an adult female weighed 109 pounds as killed, after bleeding; three adult males weighed 64, 56, and 67 pounds, respectively, after removal of head, feet, skin, and viscera.

The ear stands erect when the prong-horn is at ease, giving the animal an alert and striking appearance. When he becomes excited, the ears, which are wonderfully acute, are projected forward to catch the slightest sound. They are five inches high, three inches broad at the widest place, terminate in a point, and are covered inside and out with hair.

The eyes are black, lustrous, very expressive, and so large that taxidermists find them to exceed those of the horse and ox in size, and to be very nearly equal to those of the elephant.

[3] Adapted from Mearns, Bull. U. S. Nat. Mus., No. 56, pp. 221–222, 1907.

In summer the hair of the prong-horn is smooth and flexible, but as winter approaches it lengthens; each hair becomes thick, the interior whitens and grows spongy, and it loses flexibility, at last becoming brittle, so that its point is easily rubbed off. It also loses its elasticity, so that when once bent it will not straighten again. A coat of fine, white fur is found next the skin, particularly in winter; and forms a close and warm covering for the wearer. Doctor Murie has shown that the prong-horn is peculiar among ruminants in possessing hair with markedly denticulate cells in the medulla. In the spring, usually during the latter part of March in the Yellowstone, the long hair is shed, beginning about the face, and is replaced immediately with shorter hair that has started to grow previous to the shedding.

In female prong-horns the horns are sometimes absent or abortive, occasionally quite large, but usually range from one to three inches long and are not branched; the horns of the adult female are invariably much smaller than those of the buck. The rudimentary horns may be detected on the buck at birth, but not so in the case of the doe. The prong-horn differs from the true antelopes in the deciduous nature of the horny sheaths covering the cores. It is interesting to observe that an early printed statement about the shedding of an antelope's horns was a denial by Audubon and Bachman (1851), that they could be shed at all. This in spite of the fact that hunters at Fort Union (now Buford, N. D.) reported to Audubon that the prong-horns did shed and renew their horns annually. And from that date down to the present time the controversy has cropped up at recurrent intervals, although it has been definitely known for some time that the horns are regularly shed, but that the method and details are quite different from those of other animals. Here in the Yellowstone, at least, every buck prong-horn sheds his horn sheaths every year during November and December. At that time of year, our animals are on a restricted range and it is comparatively easy to find them all. In the course of several seasons I have noted that bucks with old horns are to be seen until the early part of December, and, after that time, all the bucks are growing new horns. No complete horns are again seen until the first of the new horns have finished their growth towards the end of January.

The horn cores (which are *not* shed) are spikelike, rising over the great eye orbit and leaning outward, and are not branched. They are essentially processes of the frontal bone of the skull, consisting of simple flattened blades of the bone, and are covered by the horny sheath which has a decurved tip and a prong, the latter a short triangular

snag extending out in front of the middle. Below the prong, the sheath is much compressed laterally to the base; but above the prong, it becomes truly cylindrical.

In early November the horn sheath becomes loosened at the base, although still held in position by long hairs imbedded in its substance and still rooted in the epidermis, and is slowly pushed off by the new horn sheath and the stiff, bristle-like hairs forming beneath. The pushing-off process is very gradual and almost invariably one sheath falls before the other; only once have I ever found a pair of sheaths together and that was in a "bed" where the antelope had lain for some time. Apparently the buck never rubs, nor strikes, his horns to free them, as an elk or a deer usually does. In fact, in several instances I have seen the horns thrown off by a sudden jar: such as, a sudden frightened jump, or the breaking of a snow crust under the animal. The imbedded hairs are mostly broken short off, but a few may be pulled free from the sheath. The shed sheath is fringed at the bottom with the ends of hairs still fast in the horn material and usually the interior of the sheath is also lined with hair. The shed sheaths immediately become articles of food for coyotes, badgers, porcupines; and even the antelopes, themselves, have been seen nibbling them. Later, after the snow is gone, mice, gophers, and ground squirrels assist in the destruction. The sheaths that escape until May begin to turn red on the side nearest the ground, and to crack and splinter, especially on the side towards the sun. This disintegration proceeds very rapidly where conditions of moisture and dryness alternate, less rapidly where moisture is constant, and still more slowly where the ground remains dry. Provided that no animal has eaten them, the sheaths are completely destroyed in from one to three years, depending on conditions already spoken of, on amount of rainfall, and on amount of exposure to dry, hot winds. Naturally the hard, compact tip is the last part to disappear. Even when freshly fallen, the sheaths are inconspicuous and not often found unless specially looked for. This differs in many respects from the process where the bony antlers of deer and elk are shed. Under the same conditions, the latter antlers are almost indestructible. Furthermore, as they "weather" they bleach and become white and are very easily seen even at a long distance.

When the sheath is off, one finds on the tip of the horn core a soft, fleshy, nipple-like process, loose and hairless and fast hardening and changing to true horn. About the base of the horn core and up to

the nipple, is a thick velvety membrane, a special development and continuation of the outer skin, carrying long, bristle-like hairs with more of these hairs extending up the horn from the base of the core. This membrane and the bristly hairs gradually agglutinate into the nipple. The agglutinated material becomes true horn, the change slowly proceeding towards the base until the whole core is sheathed with horn in which the remaining unchanged bristly hairs are imbedded, even to the very tip of the prong and well up towards the main tip. At the time the old horn is shed in November, the new horn extends down from the tip from half an inch to two inches according as the sheath was prematurely shed or not. The horny sheath forms, and extends downward about two inches per month until January first, and then about fifty per cent faster until the first of March, when the horn, in normal adult bucks, is almost a foot in height, is curved back and inward, sometimes so as to be truly lyrate. The horns of both sexes are normally black, but the bucks manage to use theirs enough to keep the tip worn down so as to expose a bit of whitish horn material beneath. The prong (one is normal but occasionally an extra one appears or two appear beside the larger one) on the growing sheath starts to grow about January first, appearing as a small button just discernible through the hair still extending up more than half the length of the coming horn. The prong grows with the sheath to completion at the same time; as it grows it loses its bluntness and becomes compressed and sharp. The horns of the kids, very small and not easily seen the first summer, start active growth in February when the kid is about ten months old and gradually swell up two inches during the next two months, and may grow from the base for ten months longer to a total height of four inches. Afterwards the horn is shed and renewed as already described. The prong appears sometimes before the youngster is two years old, but is then hardly more than an indication of what it becomes later. Horns continue to grow larger each year until the animal's full growth is attained at the age of five. The fully developed horn is recurved and normally the tip inclines inward, but on a few rare occasions I have seen the tip turned forward instead of back. This variability in direction of the recurved tip is probably due to the fact that the horn core does not extend into the bend of the sheath and therefore cannot direct its growth. Neither does the prong have the benefit of any support from the core, and its tip usually turns in more or less. The core, however, is widened, or at least marked by an abrupt angle, under the prong.

Observations on the growth and replacement of the horns of the female are lacking as yet, but I believe the process to be essentially the same as with the bucks.

Horn measurements taken from "Hunting in Many Lands," Boone and Crockett Club series:

No. 12 Theodore Roosevelt, Medora, North Dakota, September, 1884, girth 6½ inches, length 16 inches.

No. 13 A. Rogers, girth 6 inches, length 12½ inches.

No. 14 A. Rogers, girth 6¼ inches, length 10⅞ inches.

No. 13 measured from tip to tip, 6⅕ inches. The greatest width inside the horns was 8⅝ inches; the corresponding figures for No. 14 were 7¾ and 10¼ inches.

From the date when the prong-horn was first made known to science on the return of Lewis and Clark, down to the present day, it has been a favorite subject of literary efforts; many of which I regret to say, have been very fanciful. On September 5, 1804, Lewis and Clark "saw some goats or Antelopes, which the French call Cabres," (Sergeant Gass) near what is now Greenwood, South Dakota, and very close to the present state line between Nebraska and South Dakota.

Washington Irving's "Astoria" gives a good early description:

> There are two kinds of antelopes in these regions, one nearly the size of the common deer, the other not much larger than a goat. Their color is a light gray, or rather dun, slightly spotted with white; and they have small horns like those of the deer, which they never shed. Nothing can surpass the delicate and elegant finish of their limbs, in which lightness, elasticity, and strength are wonderfully combined. All the attitudes and movements of this beautiful animal are graceful and picturesque; and it is altogether a fit subject for the fanciful uses of the poet, as the oft sung gazelle of the east.
>
> Their habits are shy and capricious; they keep on the open plains, are quick to take alarm, and bound away with a fleetness that defies pursuit. When thus skimming across a prairie in the autumn, their light gray or dun colour blends with the hue of the withered herbage, the swiftness of their motion baffles the eye and they almost seem unsubstantial forms, driven like gossamer before the wind.
>
> While they thus keep to the open plains and trust to their speed, they are safe; but they have a prurient curiosity that sometimes betrays them to their ruin. When they have scud for some distance and left their pursuer behind, they will suddenly stop and turn to gaze at the object of their alarm. If the pursuit is not followed up they will, after a time, yield to their inquisitive hankering, and return to the place from whence they have been frightened.
>
> John Day, the veteran hunter already mentioned, displayed his experience and skill in entrapping one of these beautiful animals. Taking advantage of its well known curiosity, he laid down flat among the grass, and putting his handkerchief on the end of his ramrod, waved it gently in the air. This had the

effect of the fabled fascination of the rattlesnake. The antelope gazed at the mysterious object for some time at a distance, then approached timidly, pausing and reconnoitring with increased curiosity; moving round the point of attraction in a circle, but still drawing nearer and nearer, until, being within the range of the deadly rifle, he fell a victim to his curiosity.

In "Bonneville," Irving gives an interesting description of quite a different method of hunting as practiced by the Indians:

One day, the scouts, who had been ranging the hills, brought news of several large herds of antelopes in a small valley at no great distance. This produced a sensation among the Indians, for both tribes were in ragged condition, and sadly in want of those shirts made of the skin of the antelope. It was determined to have a "surround," as the mode of hunting that animal is called. Everything now assumed an air of mystic solemnity and importance. The chiefs prepared their medicines or charms, each according to his own method, or fancied inspiration, generally with the compound of certain simples; others consulted the entrails of animals which they had sacrificed, and thence drew favorable auguries. After much grave smoking and deliberating, it was at length proclaimed, that all who were able to lift a club, man, woman, or child, should muster for "the surround." When all had congregated, they moved in rude procession to the nearest point of the valley in question, and there halted. Another course of smoking and deliberating, of which the Indians are so fond, took place among the chiefs. Directions were then issued for the horsemen to make a circuit of about seven miles, so as to encompass the herd. When this was done, the whole mounted force dashed off, simultaneously, at full speed, shouting and yelling at the top of their voices. In a short space of time, the antelopes, started from their hiding places, came bounding from all points into the valley. The riders now gradually contracting their circle, brought them nearer and nearer to the spot where the senior chief, surrounded by the elders, male and female, was seated in supervision of the chase. The antelopes, nearly exhausted with fatigue and fright, and bewildered by perpetual whooping, made no effort to break through the ring of the hunters, but ran round in small circles, until man, woman, and child beat them down with bludgeons. Such is the nature of that species of antelope hunting, technically called "a surround."

Audubon on his famous trip up the Missouri River was intensely interested in the prong-horn and wrote:

Observe now a flock of these beautiful animals; they are not afraid of man—they pause in their rapid course to gaze on the hunter, and stand with heads erect, their ears as well as eyes directed toward him, and make a loud noise by stamping with their forefeet on the hard earth; but suddenly they become aware that he is no friend of theirs, and away they bound like a flock of frightened sheep—but far more swiftly, even the kids running with extraordinary speed by the side of their parents—and now they turn around a steep hill and disappear, then perhaps come in view, and once more stand and gaze at the intruder.

Judge Caton says:

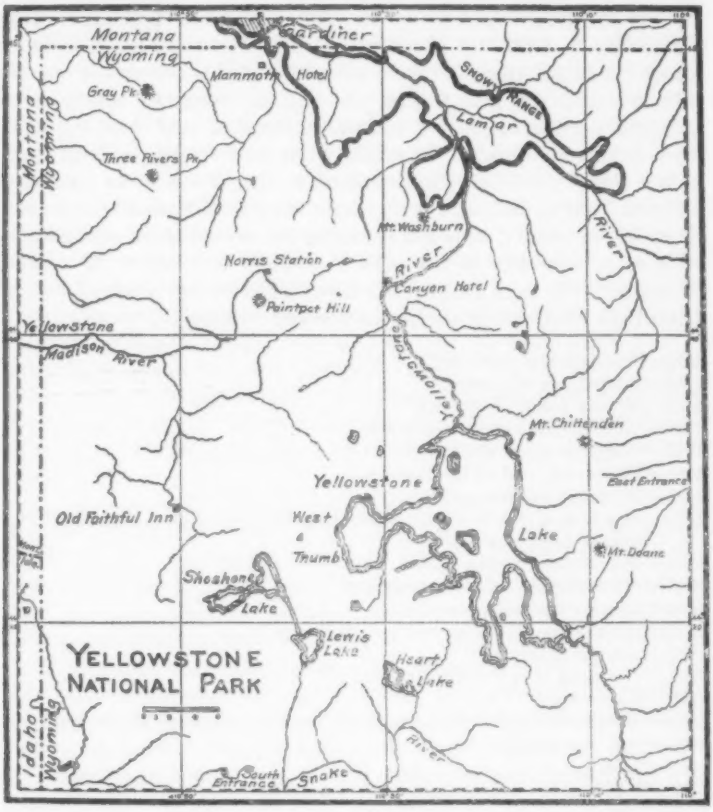
> Our antelope was an essential article of food among the aborigines inhabiting the country which it frequented before the introduction of fire-arms among them. They had various modes of capturing it, chief among which was the bow and arrow. This mode involved the necessity of getting a very close range. This could be done only by some kind of artifice, or by the most skillful and cautious stalking, always remembering its defective eyesight, its acute senses of hearing and smelling, as well as its inordinate curiosity. The latter infirmity was taken advantage of by the savage, who, approaching the game as nearly as he safely could from behind the sage bushes or other concealing object, exhibiting in irregular motion a piece of the tanned skin of the animal, colored red or white, or some other attractive object, would attract the game. When the attention of the antelope is attracted by such an object alternately appearing and disappearing, its curiosity becomes excited and an interesting struggle commences between that and its timidity; it will approach cautiously, then retreat a little, then prance around, drawing towards the object gradually, till it is finally brought within bowshot. Then it was that the Indian would let fly his arrow from his concealment, or spring to his feet, the arrow to the string, and the bow partly drawn, and strike his victim before his fleetness could carry him beyond reach.

In former days the prong-horn ranged from central Iowa to the Pacific Coast and from the Saskatchewan River to the interior of Mexico, most generally on the open plains or in broad valleys. There is no record of it being east of the Mississippi in historic times, no bones found even in the old Indian mounds, and no traditions among any of the eastern Indians.

While the present range is smaller than that of the early nineteenth century by only a few hundred miles on the east and west, the former great abundance, computed to have been as great as that of the buffalo, has sadly dwindled until now probably less than three thousand head are all that remain. As an instance of this decrease let me cite a recent report from Colorado which says that, although there are a few prong-horns left in the eastern part of the state, there is only a lone one left of the thousands that used to roam in North Park. Dr. Edgar A. Mearns in "Mammals of the Mexican Boundary" has this to say of the southwestern form, *mexicana:*

> The prong horn antelope is already [1907] a rare animal in the region of the Southwest, where it ranged in thousands twenty-five years ago. In much of the region covered by my field notes of the eighties no antelope can be found at the present day. The antelope was not uncommon from the Rio Grande to the Animas Valley during the operations of the International Boundary Commission, and antelope and deer were largely depended on for a supply of fresh meat. . . . . In 1884 great herds of them could be seen in crossing the Terri-

tories of New Mexico and Arizona by rail. Herds were frequent between Ash Fork and Whipple, along the stage route in March, 1884. At that time thousands of them were killed annually around the San Francisco and Bill Williams mountains, but none remained in the immediate vicinity of Fort Verde. About that time hunters began to comment upon its rapidly decreasing numbers throughout the region, and by the year 1888, it had become comparatively uncommon except in restricted areas still unoccupied by the whites.



DISTRIBUTION OF PRONG-HORN ANTELOPE IN YELLOWSTONE PARK

The dark line includes the antelope range, 100,000 acres.
The cross-lines indicate the winter range, 3,000 acres.

In the Yellowstone the range is restricted to the great open section in the north, comprising the Gardiner Valley, Mount Everts, Blacktail Deer Valley, the slopes on both sides of Hellroaring Creek, Junction Valley, the lower slopes of Mount Washburn on the north, the lower and upper valleys of the Lamar River, and Specimen Ridge. The whole area is below 6500 feet elevation except the table-land of Mount Everts, the upper parts of the Blacktail Deer Valley, the slopes of Mount Washburn (extending to 7300 feet), and Specimen Ridge (extending to 8000 feet above sea level). The total range includes about a hundred thousand acres out of the park's two and a quarter million acres. Of this habitat the summer range of ninety-seven thousand acres is ample, but the winter range of only three thousand acres is far too restricted, especially when snows cover the larger part of it. Forty years ago, limited numbers ranged the Swan Lake and Hayden Valleys, but such is no longer the case. Probably in former days, before white men began changing the environment, prong-horns were more numerous in the park in summer and less so in winter. That our herds have suffered a serious depletion is evidenced by the following estimates from the Superintendent's annual reports:

1877—"Thousands of antelope."
1880—"Abundance of antelope."
1885—"Several bands of antelope."
1886—"Antelope are here in large bands."
1887—"Large numbers of antelope."
1891—"Numerous, and on the increase."
1892—"Thriving and increasing."
1893—"One herd of four to five hundred wintered on Mt. Everts, and one or two smaller herds elsewhere."
1894—"500 wintered on Mt. Everts."
1895—"800 wintered on flat near Gardiner."
1896—"A great increase in number."
1897—"500 wintered in valley and on Mt. Everts."
1898—"Are yet numerous."
1899—"Not more than 700-800 in the park."
1900—"Increasing."
1902—"Number of bands of from 50 to 100 wintered on slopes of Mt. Everts."
1903—"1000 estimated."
1904—"1150."
1905—"1500."
1906—"1500."
1907—"1500."
1908—"2000."
1909—"Increasing."
1910—"600-700" (the balance reported to have escaped from the park).

1911—"450 counted."
1912—"500."
1913—"Increased slightly."
1914—"600 counted."
1918—"350."
1920—"300."

While the reports of the earlier years tell of thousands of prong-horns in the Yellowstone, it must be remembered that then there was nothing to prevent the animals from flocking up from the plains. Gamekeeper Young states in 1881 that "very few of the deer or antelope wintered anywhere in the park." A migration now to the plains would be slaughter, for if an antelope gets out of the park, it is gone as if swallowed up. The 1887 report is the earliest one mentioning that it was found necessary occasionally to drive the antelopes back from the boundary.

From 1872 to 1883 it is reported that antelopes were killed each year in the park "by the thousands." The Rules and Regulations of those days read: "All hunting, fishing, or trapping within the limits of the Park, except for purposes of recreation, or to supply food for visitors or actual residents, is strictly prohibited." And even these extremely wide-open rules were not enforced; it rather seems to have been the policy of the superintendents and their assistants to beg (!) the shooters to be moderate in their activities. With the incoming of the military regime in 1886, the rules (grown more stringent) were enforced, but there was no punishment provided for illegal hunting until 1894.

As a rule prong-horns confine themselves to the great open plains and the broader interior valleys of the mountains. They do not browse, the forest does not contain their food, and the great open ranges give their marvelous speed and matchless eyesight full scope to serve them. Still, like most rules, this has its exceptions. Frequently I find prong-horns in more or less open, stunted growth consisting of aspen, willows, or Douglas fir; often when surprised in restricted areas they show no hesitancy in entering timber to escape. Stranger still, it is reliably reported that in the southwest, prong-horns habitually lived in the open yellow pine forests of certain elevated sections.

Unless there is a scarcity of food, individuals of the antelope tribe remain within a small area of a few hundred acres. Usually they are to be found lying on some favored knoll, where they can see in all directions and can give their sense of smell full play to discover an enemy. In winter, the hilltops have the added attraction of being

swept clean of snow. Still, broad and level meadows are also favorite feeding grounds, especially on windy days.

When on migration, antelopes may travel a score or more of miles in a day. On the plains, in the old days, migration was the regular thing and well known to the hunters who frequented the spring and fall routes. Even here in the Yellowstone where the total migration is limited to thirty miles, three days is enough for these animals to travel from the winter range to the extreme limits of the summer habitat. The winter range is occupied until the latter part of February, when the large bands break up into smaller groups and the individuals show their uneasiness by keeping up near the receding snow-line; and, at the very first opportunity in early April, they break through the passes on Mount Everts and up the Yellowstone River to the summer ranges to the west. The day after they get through, they arrive on the southern slopes of the Hellroaring section, and two days later are in the upper Lamar Valley. During the migrations, it is a doe that leads the band, even though there may be several adult bucks present. But this rule is not invariable, for, about once in twenty cases, I find a male leading, especially if the band be small. Occasionally a mated pair make the migration together, for prong-horns are affectionate and much less quarrelsome than others of the large mammals. They remain throughout the summer on the higher ranges, and the first return movement becomes noticeable about September first when they move down from the heights of Specimen Ridge. As a rule the fall migration is a gradual one, the prong-horn population moving forward as a whole a mile or two a day with many halts, unless an early storm accelerates the movement. About the same time that the migration starts at the western end, the first migrants appear at the eastern end on the winter range. While the migrating prong-horns remain in pairs and small groups in September and early October (or the duration of the rutting season), they begin to gather in large bands soon after that. During October, all the antelopes leave the upper Lamar Valley, Junction Valley, and the Hellroaring Range. Some linger a few days on the forage ranges about Blacktail Deer Creek, and many stay during November on Mount Everts; but usually by December first all are on the lower ranges just across the park boundary from Gardiner, Montana, extending up the lower slopes of Mount Everts. To be sure this schedule is average; weather conditions may retard or accelerate the movement considerably at any stage. Even on the winter ranges temporary changes of weather cause the prong-horns to move up or down

as the snow-line changes and uncovers more or less ungrazed forage. In spite of their warm coats, these animals are susceptible to changes in temperature and are prone to seek shelter, especially from cold north winds. On the other hand, they do not seek shelter in summer from the blazing sunlight. In common with many other animals, they have some sense of foretelling weather changes and when we observe a certain nervousness and uneasiness in the prong-horn bands, we have learned to look confidently for a storm in a day or two.

As with all animals, there are erratic individuals in the antelope herds. A few stay all summer on the lower ranges, and one winter was notable for the successful stay of a small buck in the willows along the Lamar, where he subsisted on hay spread each day in the buffalo pasture at the Buffalo Ranch.

The migrating bands of the old days on the great plains numbered prong-horns by the thousands and those on the northern plains regularly moved south with the first fall of snow. But by the beginning of the twentieth century their numbers had fallen to such an extent, and the individuals had scattered so far, that large herds could gather no longer.

The prong-horn has a wonderful eyesight. As Geo. W. Wingate says, "the hunter must never assume that any antelope he sees, even with a glass, is not watching his movements." Not only is the eye large, but it is placed on the side of the head in a prominent place so that it indeed seems "that they can look out of the back of their heads." Personally I have had animals a half to three-quarters of a mile away see me the instant I moved an inch. Timid and suspicious as they are, they are liable to panic, and will dance up and down; but when once started they are very fleet for a short distance. Unless in good condition, they may then become fatigued. When going slowly, they walk or trot, at times making use of a gait consisting of a series of stiff-legged bounds; but when in a hurry, they run, hugging the ground closely and using every available ounce of strength to accomplish distance. So amazing is their speed, even faster than the deer's, that it is frequently said that "them antelope have sure stampeded." With first-class greyhounds and good horses prong-horns can sometimes be run down, but without these dogs the best a good horseman can do is to get within two or three hundred yards. The average breed of dogs stand little chance, even when hunting in packs, for the antelopes usually run away from them. Prong-horns, when once started, are very loath to change their course so that it is often possible to dash quite close to them by darting ahead at an angle towards their line of

flight. They can make astonishing horizontal leaps, but are not high jumpers ordinarily.

Cutaneous glands and hair tufts are absent from the limbs, but occur at the base of each ear, behind the hocks, one on the lower back, one on each buttock, and one interdigital gland on each foot—eleven in all. But the lachrymal glands and sinus are absent, although often found in the Bovidæ. The buttock glands and the dorsal gland are not found on any of the Bovidæ that I know of. When the rump hair is raised or lowered a strong, musky odor is given out, and it is suggested by Dr. R. W. Shufeldt that the office of these many glands is to furnish an odor to protect the animals from the swarms of insects such as gnats, mosquitoes, and flies.

Prong-horns do not seek to elude observation, all they care about is to be able to see for themselves. Their habit of lying on a commanding knoll to give full scope to keen eyesight has already been spoken of; but they often take the opposite course and lie in a hollow to get out of a breeze, which they do not seem to like. They also are apt to face towards the wind to give their ears and noses the very best opportunity to detect the approach of an enemy. While ordinarily the color is a conspicuous one, still it has some protective value. I remember once seeing a stone the same color as an antelope, but when I got opposite to it, to my great surprise a big buck antelope jumped up. And I often have the opposite experience and have a prong-horn turn out to be a stone on closer examination!

These animals can swim when necessary, often fording swift and deep streams (on one occasion I saw a spring flood dashing high over a swimming prong-horn, which, although swept downstream at considerable speed, kept bravely on and finally got across), but I do not see them standing in water as deer and elk do, nor do I often see them bathing. In fording a stream, they do not stop to drink as elk usually do; and I notice that in every case antelopes have left the water on the run and have gone quite a distance before even stopping to shake themselves. Perhaps they do not like to risk being between the high banks that most of our streams have.

In their eating, prong-horns confine themselves largely to various grasses, preferably those like the gramma, buffalo, and bunch grasses that cure well on the stalk. They are also fond of alfalfa and will strip the heads from any vagrant oat stalks they find; but they cannot live on the rich, green grasses of the East. I have never seen any evidence of browsing on bushes and trees, except that they eat leaves

from the *tridentata* sage quite freely, even when forage is plentiful. Their hours for feeding are irregular, but when they are feeding, prong-horns crop their food for about an hour, then lie down and "chew the cud" for thirty to forty minutes before resuming grazing. I have never seen antelopes paw away the snow, as do deer and elk, nor have I ever found any spots so uncovered by them. The ones I have watched preferred to hunt a bare spot, or selected a thinly covered space where they could push the snow aside with their noses. Prong-horns are dainty eaters, picking out only the cleanest and best of the grasses; and avoid all stretches already grazed by domestic animals, especially sheep. When forage is good, they become fat and strong, and the kids develop much faster than during lean years. I believe, too, that horn growth is stronger and better after a good summer and autumn season. Prong-horns are fond of "soda licks," and at times take some of the salt put out for the buffaloes; in winter they often eat snow in preference to hunting up the scarcer open water. When they do seek water, they are as apt to do so at noon as at any other time of the day.

It is rather difficult to be positive on such a point, but all my notes seem to show that prong-horns are quieter during the night and not given to moving about nor eating so much as in daytime. Certainly they are less nocturnal than deer and elk. Quite often they spend the nights on hills and elevations, and move down to the valleys to feed in the morning.

The rutting season is in September and October, at which time antelopes are found in pairs and small groups of three, four, and five, but I see no evidence of the "harem" habit of the elk, where the male gathers together as many of the other sex as he can. Courtship seems to consist largely in swift running matches wherein the doe runs away from the buck, or suffers herself to be caught, as she sees fit; for she evidently is the speedier of the two. I am inclined to rate this animal very high on the score of family associations. It is true that prong-horns combine in large bands during the winter months for mutual protection, but about the first of February they disband into couples and small groups. All through the spring and summer I find couples and small family parties, with the bucks living peaceably with their wives and families. At times the buck on a knoll often mounts guard over them to prevent surprise while they feed quietly below. But it often happens that two rival bucks are found fighting during the mating season, and I have seen a small buck driven out of a small

band of does and kids by a larger and stronger buck. Usually the contests do not develop into a battle; the weaker animal gives up after a pass or two and is chased off by the victor. Where a fight does develop the two bucks come together head on, then each strains hard to push his rival back. After a minute or two, one suddenly springs away, turns, and is off like a shot with the other in hot pursuit for a half mile or more. At other seasons they seem even more peaceable, and I can only attribute the fact that almost every shed horn found is marked with scars, to the fact that the sheath is comparatively soft and that they are shed so soon after the rut is over.

The period of gestation is a little over eight months or slightly longer than with deer. Late in May, or early in June, the doe retires to some secluded spot and there the kids are born, usually two at a time. Compared with deer and elk of the same age, a prong-horn baby is unusually strong and reliant. True it trusts largely to hiding to escape its enemies, but if necessary, it can run quite fast. If the mother has any chance at all to fight for her youngsters, she will attack at once and fight with great intrepidity. She uses her sharp hoofs with fine effectiveness, striking a quick, downward blow with her fore feet that easily disables a coyote or similar foe. There being no rattlesnakes in the Yellowstone, I cannot confirm of my own knowledge that she can cut one to pieces before he can strike, but I do believe it probable. That the young are efficient in their fight for existence is shown by the number that survive the first year. In the spring of 1921, I found by careful count that almost 19 per cent of our herd were young ones approaching one year old, this figure being much higher than for our other large animals. I remember well a little fellow found one fourth of June; I did not see his twin until later, and the mother, not at all. He was unseen until I almost stepped on him; when he ran, he started at once at full speed, and so astonishing was his speed he seemed fairly to fade from sight into the misty rain that was falling. He was somewhat lighter in color than the adults, and with markings nowhere near as distinct, but his coat served him well, protectively, among the gray glacial boulders of his native bench land. Later I found his brother in the lee of one of these same boulders. Judging from what I have seen, new-born kids are capable of withstanding quite severe cold spells, and storms of snow and hail.

Sometimes I find old bucks off by themselves; but there are enough exceptions, so that I would not feel safe in saying either that hermitage was usual for the old fellows, or that it was not. As I have said before,

family parties are frequently seen in summer, and in winter prong-horns certainly are social and gregarious, all our animals gathering together in one or two large bands. As far as other species are concerned, they evidently prefer to be by themselves. I see no evidence of antagonism, but an antelope's disposition seems to be to avoid all other animals. Occasionally they are with deer, elk, mountain sheep, and even buffaloes, but the association is due to limited forage and not at all to sociability. The prong-horns always shy off from the larger animals, do not relish their proximity, and even go so far as to decline forage over which elk and domestic sheep, cattle, or horses have grazed. Two or three times I have seen them running from pursuing buffaloes and elk.

In addition to being peaceable and friendly among themselves, many of the antelopes get strangely tame and confiding towards us. In riding horseback along our roads, I have passed within twenty feet without disturbing them in the least. Yet they vary a good deal, and individuals that I marked one day as tame, were met the next day on migration and were extremely nervous and wild. In fact, I have found prong-horns much wilder and more suspicious on migration than at other times.

Timid as they are, prong-horns have such a developed sense of curiosity, that it serves them ill against man; in the case of their natural enemies, their matchless speed will usually carry them out of any danger their curiosity gets them into. Since the days of Lewis and Clark, hunters, taking a leaf from the Indians' method, have made use of a red flag to entice the curious animals within range of their rifles. Nor is it necessarily red, any color will do, the more conspicuous the better. If no flag is convenient, the hunter lies on his back and kicks one foot quickly up and down. In fact any strange object, or any strange motion, will do the trick.

On one occasion a buck prong-horn on a river bottom saw two elk coming down a hill a mile away, ran to and around them, and then back to where he had been originally. On another occasion, I got off my horse and left him to graze while I examined a bird-nest I had discovered. Soon a female antelope came up over a hill and spied the horse; immediately she began to display great curiosity, circling about, and gradually working nearer, but frequently whirling as quick as a flash, and away at full speed for a hundred feet, only to draw nearer once more. When a vagrant eddy of wind carried a scent of me to her, she was off in earnest and ran clear out of sight; but even then after a short stay, she was back again for another look!

On another day on the main road, I had a small male antelope come up to within a hundred feet to watch me ride past. As I did so, he squealed and stamped first one fore foot and then the other, and then trotted up and crossed the road in front of my horse. On another occasion I approached a group of twelve animals standing on a knoll. Most of them moved off, leaving one that permitted me to pass within fifty feet. After I had passed he started suddenly to run and was almost instantly at full speed and seemed to grow more and more frightened the farther he ran.

Such occurrences are common enough almost daily; and when we are in camp on the prong-horn range, we so often have a single animal, or even a group of three or four, come up to inspect camp and stay about for some time, that it arouses little comment. Where blinds are built for photographic purposes, they usually result in attracting, sooner or later, most of the antelopes in the vicinity. My experience has been that single animals are more apt to show this inordinate curiosity, still I have had considerable bands come close to my blind at times.

Naturally the broad open plains on which the prong-horns live, and the fact that they depend more on eyesight and their sense of smell, make calls and sounds more or less superfluous and create the necessity for other signals. They have an alarm note that might be described as either a squeal or a bark, and they use it when curious as well as when alarmed. But one of the great characteristics of this animal is its "signalling" with its rump patch, whose dazzling white hairs can be erected or depressed at will. In times of excitement, alarm, and pain, these patches are erected, forming two "great chrysanthemum-like white rosettes," as Dr. E. W. Nelson expresses it, that instantly attract attention and can be seen for a long distance. The prong-horn, first giving the signal, turns so that all his companions can see it, sometimes it is constant and sometimes the alternate raising and lowering gives a quick series of flashes. A second animal seeing the signal, repeats and the alarm is flashed from point to point across the plains as if from a series of heliograph stations. Then all the animals run together into a small, compact band, if it is at all possible. As they dash away, the white signals can be seen for a long distance; as the animals halt and face about, the signals disappear and the otherwise neutral color causes the animals to fade out as by magic. But if there is still cause for alarm, the white signals flash out again and again long after the rest of the animal has become invisible. Upon investigation it is found that there is a mass of muscle underlying the buttock patches and glands

and all interconnected. As soon as the animal is excited these muscles act, perhaps involuntarily, the hairs are raised and the glands are exposed, releasing a musky odor noticeable to man's poor nose for quite a distance, especially down wind. No doubt the superior nose of an antelope can detect it a mile away on open ground. Has this animal, perhaps, a second odor meaning that the exciting cause is ended, or that it is not dangerous?

In captivity antelopes are trustful, affectionate, and fond of being noticed; very playful when young, their growing strength soon makes them too rough for human companionship although I have yet to hear of one that became actually vicious. They like to follow people about, but apparently never lose their extreme nervousness; even a dislodged pebble being sufficient to put them to flight in terror, although they soon come back again. At such times the youngster, that may never have seen an adult do it, will instinctively "flash" his signal. The usual run of dogs bother little even a very young antelope, which has no difficulty in outrunning a pack of them.

Unfortunately, prong-horns are very hard to keep in parks and zoological gardens, and indeed anywhere off the great, dry, open ranges that produced them. The superintendent of one of our zoological gardens writes me that out of thirty-two specimens only a few lived over one year, and that their best record was one that lived five years. I have heard of only two or three instances where young have been born in captivity and they did not live long in any case. Antelopes seem very susceptible to diseases and especially parasites of one kind or another. Their food must be carefully chosen for they do not live on a diet of rich green grass. A ration of rolled oats, clover, and a very little grass, with a little salt two or three times a week, has given the best results. But in addition to these difficulties, the great trouble seems to lie in the extreme timidity and nervousness that gives a captive so little rest and tranquility.

In common with other animals, their life on the broad open ranges keeps them comparatively free of diseases; practically all of their troubles of this kind being due to infection from domestic sheep, cattle, and horses.

Prong-horns in captivity suffer from pneumonia, malignant catarrh, pyemia, congestion of the lungs, and ulcers; most of these are climatic diseases and have not been serious among our Yellowstone animals. But with actinomycosis, or lumpy-jaw, the case is different. Some of our elk, deer, and antelopes have died from this disease; and in the

case of the last animal, the disease is particularly virulent, and few, if any, recover from an infection.

Internal parasites are of several kinds that infest domestic sheep, goats, and cattle—tape worms, stomach worms, whip worms, and hair worms. There is also a tape worm found in foxes, wolves, and coyotes, which in the embryo stage is found in our antelope.

External parasites that we must guard against are the wood tick and the scab mite; both of which are dangerous because of debilitating effect on the victim.

For approximately three months, from about the first of November, prong-horns gather together in large bands for mutual protection. This period corresponds with the growing season of the bucks' horns, when they are least able to defend themselves. It is interesting to observe that during these three months, the bands are led by the does although there may be several full-grown bucks present. More than once I have seen a band, when climbing a low elevation, stop before it reached the crest, permitting the leading doe to run up and look over to examine the country ahead for some minutes before she returned to lead the band up and over. Prong-horns are usually watchful enough to prevent the close approach of an enemy, for it is their rule to occupy good lookout positions, and they frequently have sentinels posted whose only duty is to watch while the rest feed.

Coyotes, especially when banded together in packs, are the most dangerous of the antelope's enemies. Even so, I do not believe they catch many of the healthy adults, although a few of the old and diseased animals fall victims. Undoubtedly the coyotes cause additional damage by worrying them, and keeping the nervous animals stirred up and excited. The gray, or timber, wolves kill a few antelopes, although as a rule they confine their attacks to larger and slower animals. Owing to the peculiar rough and broken character of our winter range, affording good lurking places, the mountain lions manage to kill a few under exceptionally favorable circumstances. I doubt if a bear can catch a prong-horn unless he finds a very young kid hiding. Buffaloes occasionally kill very small kids, but as a rule, even the youngest are speedy enough to escape. The only birds I can think of as possibly dangerous, are the great golden eagles; there I should say the danger was small because other game, during the extreme youth of the kids, would be easier to get.

It is extremely difficult to determine how long antelopes live. They reach maturity at five, and, as a rule, live from three to five years

longer, although at times an individual reaches the ripe old age of twelve or fifteen years.

Dr. R. W. Shufeldt tells of an unusual animal seen six miles north of old Fort Fetterman, in Wyoming. Of a band of nine antelope in a shallow valley

> the largest buck, a full-grown and splendid specimen, had jet black head and shoulders, while the coloration of the rest of his body was normal. A case of melanism of an antelope—where the condition was confined to the head and shoulders—must certainly be one of the rarest occurrences in nature.

Although the great abundance of the antelope in the old days made sure an ample supply of meat for the use of the hunters, red and white, the quality of this meat, which is described by one authority as "delicious" and by another as "highly relished by everyone who has ever partaken of it," only served later to hasten the destruction of the animal. The secretion from the glands, although strong and musky, does not affect the flesh in any way. Until late in the 70's the Indians on the plains depended to no little extent on the antelope for meat, especially when deer, elk, and prairie-dogs could not be obtained.

Dr. E. W. Nelson says:

> In 1884 antelope still existed in large numbers at many points in the Rocky Mountains from near the Mexican to the Canadian border. We killed antelope, deer, or elk for ranch use throughout the year without a thought that the supply was not perpetual.

And Col. Theodore Roosevelt has written, "On my ranch it has always been the animal which yielded us most of the fresh meat in the spring and summer."

I have already related how hunters, Indians as well as white men, made use of the antelope's great curiosity to lure them to destruction by waving a red shirt, a bit of colored cloth, or other unusual but plainly seen object. But the Indians had other methods of hunting. It is known that they sometimes surrounded a herd, driving it into the water where the game could be easily slaughtered with arrows. Some of the tribes who had plenty of horses in suitable country, sometimes ran antelopes down by using relays of riders previously posted about a small band. It must be admitted though, that this method was very unproductive of results, often requiring a day's hard work on the part of twenty Indians and horses to secure one or two hundred pounds of meat.

But there was another method much more productive, and used by widely separated tribes. In his Snake Dance of the Moquis, Capt. John G. Burke gives the following:

> We passed, near the Hopi villages in northeast Arizona, close to an antelope "corral" of the Navahos. These are made of two converging lines of stone and brush. The Navaho warriors, mounting their fleetest ponies, will scour the country for miles, driving before them the luckless game, which after a while reaches the narrowest point of the corral and then falls a victim to the hunters in ambush. The Indians are careful not to kill all, but to allow a few to escape. This forbearance is partly based upon a desire to allow the game to reproduce, and is partly religious in character.

And in the Lewis and Clark report:

> A camp of Mandans caught within two days one hundred goats [prong-horn] a short distance below us. Their mode of hunting them is to form a large strong pen or fold, from which a fence, made of bushes, gradually widens on each side: the animals are surrounded by the hunters, and gently driven towards this pen, in which they imperceptibly find themselves enclosed, and are then at the mercy of the hunters.

This same method was used in the upper Yellowstone country by the Crows and Blackfeet. Even now there is the remains of an old "corral" essentially as described, near Reese Creek, three miles north of the northern boundary, and another near Emigrant, Montana, thirty miles farther north.

Perhaps another reason for the destruction of these beautiful animals was that they could be hunted at all times of the day, even during the noon-day hours when it was almost useless to try for deer and elk. On the other hand, antelopes were not only shy and wary and hard to approach, but they were also hard to kill. Colonel Roosevelt has stated that it was astonishing how fast a wounded animal, even when a leg was broken, could run unless given a more crippling wound. Even after having fallen, antelopes have been known to get up, throw off the hunters that may have laid hands on them, and escape. In contrast to the desirability of the meat the hides, either dressed as fur or tanned into leather, were not highly valued.

BIBLIOGRAPHY

AUDUBON AND BACHMAN, Quadrupeds of North America, II, pp. 193–205, 1851.

BAILEY, VERNON, Old and New Horns of the Prong-horned Antelope, Journal of Mammalogy, pp. 128–129, May, 1920.

CATON, J. D., The Antelope and Deer of America, pp. 21–65, 1877.

BUCK PRONG-HORNS, JANUARY 20, AT A TIME WHEN THE HORNS ARE ABOUT HALF FORMED

An examination will show the hard upper half, with the bristly hairs extending up from below. The lower picture shows the standing buck with "signal" raised.

(Skinner: The Prong-horn)

SHED HORNS FROM A THREE YEAR OLD AND A FIVE YEAR OLD BUCK

Both show the short curly hairs at base. The smaller horn also shows the start of two additional prongs below the main prong.

PRONG-HORN SHEATH, JUST SHED

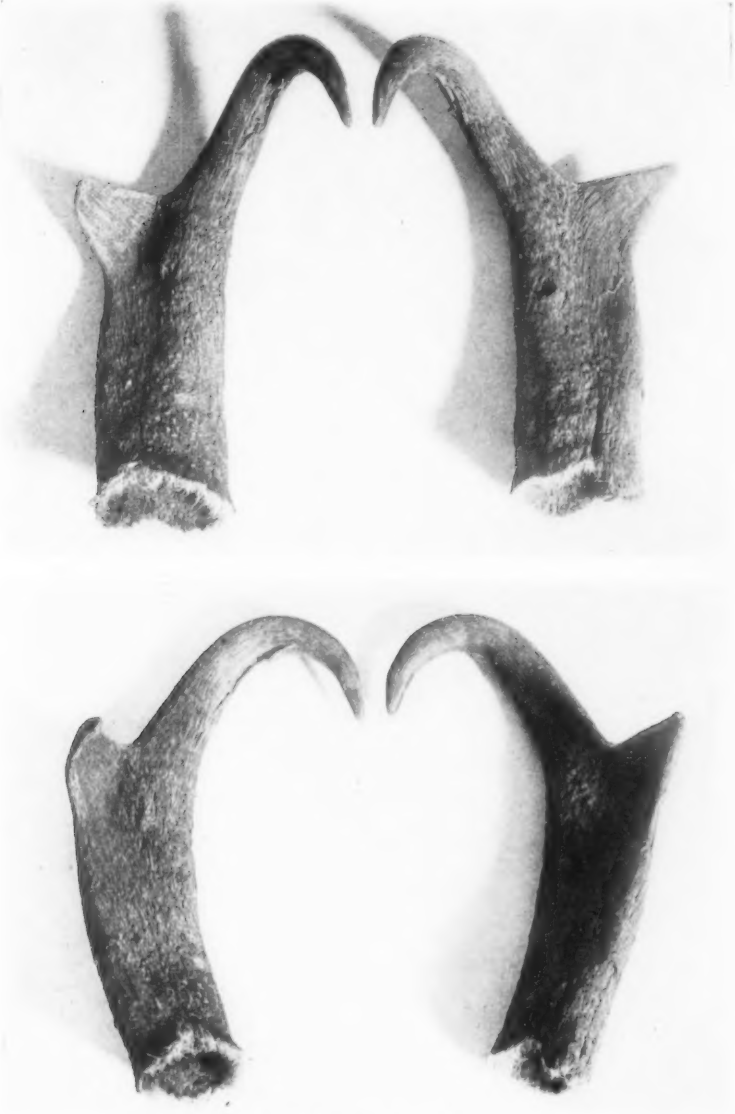
Note the short white hair curling up from base. The roughness between base and prong is probably due to injury when fighting.

(Skinner: The Prong-horn)

SHED HORNS SHOWING PROGRESS OF DESTRUCTION

The horn on left was freshly shed; the next had been shed about five months; the next about seventeen months; and the one at extreme right also seventeen months, but had fallen in a place suitable to more rapid destruction.

(Skinner: The Prong-horn)



THE ONLY TRUE PAIR OF SHED HORNS FOUND BY AUTHOR

The injuries inside both tips are typical fighting scars. In the lower figure the horns are turned to show the natural front view.

(Skinner: The Prong-horn)

COMMITTEE OF BOONE AND CROCKETT CLUB. Size of horns in Hunting in Many Lands, The Book of the Boone and Crocket Club, pp. 429, 1895.

GRINNELL, GEO. BIRD, Shed Horns of the American Antelope, Journal of Mammalogy, p. 116, May, 1921.

HORNADAY, W. T., The American Natural History, p. 116–118, 1906.

JONES, E. LESTER, Future of the Antelope, Proc. of the National Parks Conference, pp. 205–207, Jan. 2–6, 1917.

LEWIS AND CLARK, under date of Sept. 6 and 17, 1804.

LYDEKKER, R., The Great and Small Game of Europe, Western and Northern Asia, and America, pp. 333–338, 1901.

LYON, M. W., Remarks on the Horns and on the Systematic Position of the American Antelope, Proc. U. S. National Museum, XXXIV, pp. 393–399, 1908.

MEARNS, EDGAR A., M.D., Family Antilocapridæ, Mammals of the Mexican Boundary of the United States, U. S. National Museum Bulletin 56, pp. 220–232, 1907.

NELSON, E. W., The Larger North American Mammals, National Geographic Magazine, pp. 452–453, November, 1916.

NELSON, E. W., in Proc. of the National Parks Conference, p. 201, Jan. 2–6, 1917.

ROOSEVELT, THEODORE, Trail and Camp Fire, The Book of the Boone and Crockett Club, pp. 204–211, 1897.

ROOSEVELT, THEODORE, American Big Game Hunting, The Book of the Boone and Crockett Club, pp. 129–132, 1901.

ROOSEVELT, THEODORE, The Deer Family, pp. 98–130, 1902.

SETON, E. T., Life Histories of Northern Animals, I, pp. 209–246, 1909.

SHUFELDT, R. W., The American Antelope. American Forestry. Pp. 745–754, Dec., 1920.

STONE AND CRAM, American Animals, pp. 54–57, 1905.

WHEELER, OLIN D., The Trail of Lewis and Clark, I, p. 177, 1904.

WINGATE, GEORGE W., Through the Yellowstone Park on Horseback, pp. 211–213, 1886.

See also:

IRVING, WASHINGTON, Astoria, II, pp. 18–20, London, 1836.

IRVING, WASHINGTON, Bonneville, pp. 471–472, New York, 1869.

Yellowstone National Park, Wyoming.

ON THE "HABITUS" AND "HERITAGE" OF CÆNOLESTES

By William K. Gregory

The more closely one studies Dr. W. H. Osgood's excellent monograph on *Cænolestes*[1] the more one must be grateful to him for the quality and range of his plates, for the thoroughness of his comparisons (within the limits of available material) and for his eminently fair and impartial presentation and analysis of the difficult subject of the precise relationships of that animal to other marsupials. Doctor Osgood's monograph has already been reviewed in a recent number of this journal[2] and I have no wish to offer detailed criticisms or to challenge the author's main conclusions. But a careful study of this work and of Lönnberg's recent brief paper[3] has resulted in the following preliminary and partial analysis, in which an attempt is made, first, to bring out the correlation of habit and structure, and secondly, to make a beginning towards separating those features which have been acquired during the present life habits (habitus) from those which have been inherited from previous life habits (heritage).[4] Unless otherwise noted the statements of anatomical fact are to be credited to Osgood.

I. LIFE HABITS AND ECOLOGY

1. *Geographic Distribution.* Present: Andes of Venezuela, Colombia, Ecuador, Peru. Past: *Cænolestes* is a survivor of the Santa Cruz Miocene Epanorthidæ (Palæothentidæ) of Patagonia.

2. *Life Zone.* Cool, dense forests at high altitude, 6 to 12 thousand feet, near timber line. Also in grassy openings of mountain valleys. *Cænolestes* lives in dense growth, beneath the canopy of the tree tops and still further shaded by masses of low vegetation. Osgood infers that it is crepuscular or nocturnal in habits. Found in runways among the thick grass in swampy ground, about on a level with the water line of the swamp. Lönnberg (1921) says it is arboreal in habits, but this seems doubtful.

[1] A Monographic Study of the American Marsupial, *Cænolestes*. Field Mus. Nat. Hist., Zoöl. Ser., vol. 14, no. 1, pp. 1–162, May, 1921.

[2] Journ. Mammal., vol. 2, no. 4, pp. 241, Nov., 1921.

[3] A Second Contribution to the Mammalogy of Ecuador, with some remarks on *Cænolestes*. Arkiv. f. Zoöl., Bd. 14, no. 4, pp. 1–104, 1921.

[4] Gregory, 1913. Locomotive Adaptations in Fishes, Illustrating "Habitus" and "Heritage." Ann. N. Y. Acad. Sci., pp. 267–268; Osborn, 1917. Heritage and Habitus, Science, N. S., vol. xlv, no. 1174, pp. 560–561.

3. *Food Habits.* Examination of three stomach contents reveals remains of weevils, caterpillars, lepidopterous pupa, adult lepidopteran, leg fragments of orthopteran, tipulid larva, centipede, spider. Dipterous and lepidopterous remains form the major portion (in one case 60 per cent). Animals caught in traps showed preference for meat bait. Nothing known directly of methods of catching food, but there is much anatomical evidence which will be discussed below.

4. *Locomotor habits.* Only definite fact of field observation is that animals move about freely and are terrestrial, often going through runways. Much anatomical evidence.

5. *Protective habits and reactions.* No direct testimony.

6. *Breeding habits.* Ditto.

II. HABITUS AND HERITAGE OF THE FOOD-GETTING AND FOOD-REDUCING SYSTEMS

A. Habitus

The food habitus involves primarily the organs of detection, prehension, occision, mastication, deglutition, ingestion, digestion, assimilation, circulation and excretion. It involves secondarily other systems, such as the locomotor and the controlling or nervous, adjusting systems.

Cænolestes feeds on insects by means of the following adaptive characteristics:

1. *Organs of detection.*

a. *Sight* poor. Eyes small, orbits small, optic nerves and foramina and nerves of eye-muscles all small.

b. *Smell* very highly developed. Very large olfactory bulbs and tuberculum olfactorium. Chiefly an olfactory brain. Large olfactory fossa in braincase and large snout. Expanded olfactory chamber with four large ethmoturbinals and one nasoturbinal.

c. *Touch.* Sensory vibrissæ on snout and cheeks. Very large superior maxillary branch of fifth nerve for nose and lips.

d. *Hearing* acute. Very large external ears and large inner ear.

2. *Organs of prehension and occision.*

a. *Prehension.* Orbicularis oris and buccinator muscles well developed. Maxillo-labialis or levator muscles of lips rather weak. Labrets on upper and lower lips recall those of kangaroos. May be used for holding or ejecting food? Tongue long, fleshy, pointed, under surface sharply keeled, the keel extending beyond the tip of the tongue, fitting into the interspace between the two long anterior incisors. It represents the median portion of the sub-lingua (Lönnberg).

b. *Prehension and occision.* Upper and lower incisors remarkably kangaroo-like for prehension and cutting. Large papilla incisiva, also kangaroo-like. Opposes lower incisors. Incisor arrangement functionally more or less shrew-like. Palatal ridges closely resembling those of the Macropodidæ and *Eudromicia* among the Phalangeridæ (Lönnberg). Upper premolars small, pointed; coöperate with small lower incisors and lower premolars to kill insects.

3. *Organs of mastication.*

a. Upper and lower molars (Fig. 1. Description by present writer): m_1–m_3 tuberculosectorial, with expanded posterior V and large talonid basin. The large talonid implies a large protocone in the upper molars;

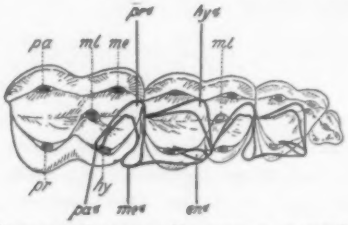


FIG. 1. DIAGRAM SHOWING OCCLUSAL RELATIONS OF THE PARTS OF THE UPPER AND LOWER MOLARS.

The metacone (*me*) and metaconule (*ml*) of the upper molars have their normal spatial relations with the parts of the lower teeth.

UPPER MOLARS	LOWER MOLARS	
	Trigonid	*Talonid*
pr, protocone	pr^d, protoconid	hy^d, hypoconid
pa, paracone	pa^d, paraconid	en^d, entoconid
me, metacone	me^d, metaconid	
ml, metaconule		
hy, hypocone		

the greater transverse width of the talonid as compared with the trigonid invariably implies that the para- and metacones are well separated. The fact that the trigonid basin is well above the level of the talonid basin implies that the protocone is higher than the hypocone. The marked anteroposterior length of the first three lower molars implies a corresponding lengthening of the upper molars.

There is practically no trigonid basin in the fourth lower molar and so there should be, and indeed there is, no hypocone on the third upper molar. The enlarged entoconid of m_{1-3} fits lingually between the proto- and the hypocone.

The metaconule (ml) of the upper molars furnishes an additional cutting blade that works between the hypoconid of one lower molar and

the protoconid of the one behind it. Doctor Osgood suggests that this small cusp may represent a reduced metacone and that the two main outer cusps are derived from the styles; but, as shown in Fig. 1, the two main outer cusps have practically the normal occlusal relations of para- and metacones, while the stylar cusps of *Perameles* are here represented by the external cingulum. All this arrangement of shearing blades would be well adapted for cutting and dividing the chitinous bodies of insects.

The fourth upper and lower molars are reduced in size precisely because the first three are enlarged and because there was no room for expansion backward without encroachment upon the space filled by the strong jaw muscles.

b. *Jaws.* Jaw movements (as inferred from experiments with skulls and mandibles) remind one somewhat of those of herbivores, perhaps because chitinous bodies may be somewhat like grass stems in cutting properties. As shown in American Museum specimens of *Cænolestes*, the lower molars move from below, upward, forward and inward. In using the tip of the lower central incisor the animal brings the condyle forward to the front part of the smooth glenoid; the dorsal edge of the long lower incisor shears past the compressed second and third upper incisors.

Jaw muscles recall artiodactyls and especially kangaroos; but the most exceptional feature is the large size of the external pterygoid which is two-fifths the size of the internal pterygoid and double-headed, inserting at base of mandibular condyle and on stylomandibular ligament. Possibly associated with forward oblique pressure of lower molars on upper.

Bony jaws: upper jaw (including zygoma) on the whole rather more slender than in primitive insectivores; lower jaw with large areas for masseter and internal pterygoid muscles.

4. *Organs of deglutition and digestion.*

a. Parotid and submaxillary glands very large.

b. Throat muscles apparently primitive and normal.

c. Stomach with strongly differentiated glandular area forming a compound gastric gland, comparable in part to *Phascolarctos*, *Phascolomys*, and *Manis*. Stomach unique.

d. Large intestine relatively short.

e. Colon short, with very small cæcum.

f. Liver relatively large.

g. Pancreas extensive.

B. Heritage

Accepting the views of Huxley, Dollo, Bensley, Osgood and others that the existing Didelphidæ stand near the center of the adaptive radiation of the marsupials (a view endorsed by Matthew, 1913, on palæontological grounds) we find that in its nutritional habitus *Cænolestes* is almost intermediate between the primitive insectivorous polyprotodonts and the more primitive Australian diprotodonts, such as *Distæchurus* of the Phalangeridæ. Thus in the dentition it inherits from the polyprotodonts the primitive dental formula, the tuberculosectorial character of the lower molars, the remnants of trituberculy in the upper molars, and of the external cingula in both the upper and the lower molars. On the other hand *Cænolestes* has advanced in the direction of the diprotodonts in acquiring fully developed diprotodonty of the front teeth, and a remarkably kangaroo-like papilla incisiva, while the upper and lower molars approach the pattern of those of the smaller phalangers. But neither in *Cænolestes* nor in any of its known extinct relatives is the dentition as a whole sufficiently close to those of Australian diprotodonts to warrant us in referring them to any given Australian family. In comparison with that of *Perameles*, the dentition of *Cænolestes* differs radically; for the former may best be derived as by Bensley (Pls. 5, 6) from some small polyprotodont, such as *Peratherium*, with inwardly grown para- and metacones and heavily developed buccal stylar cusps. In the Peramelidæ the dentition, while remaining polyprotodont in front, has become hyposodont in the cheek teeth, while *Cænolestes* has acquired diprotodonty in the front teeth and incipient lophodonty in the cheek teeth. In brief, as regards its dentition, *Cænolestes* and the whole family of Palæothentidæ may represent an independent group not directly ancestral to any Australian diprotodont, but lying between the Peramelidæ and the Phalangeridæ, as suggested by Osgood.

In respect of the organs used in detecting the food, *Cænolestes* may well represent a secondary specialization in the excessive size of its olfactory, tactile and auditory organs and in the reduction of the sense of sight which is fairly well developed in the smaller Didelphidæ.

With regard to the stomach, which is peculiarly specialized, Osgood remarks (p. 72) that this organ is unique and serves to strengthen the general conclusion that the animal stands by itself quite as independently as any of the highly specialized Australian forms. Osgood also remarks (p. 78) that the short colon combined with the small cæcum in *Cænolestes* is contrary to the usual condition in marsupials and is

most nearly met in certain of the dasyures, and that although the short colon is perhaps primitive, the small cæcum is obviously a secondary condition.

In brief, to judge from its nutritional habitus as a whole, one might infer (as Doctor Osgood does) that *Cænolestes* is a descendant of that part of the primitive polyprotodont group which gave rise both to the Peramelidæ and to the Australian diprotodonts.

III. HABITUS AND HERITAGE OF THE LOCOMOTOR APPARATUS

A. Habitus

The locomotor habitus involves primarily the locomotor system of nerves, muscles, connective tissue, ligaments, axial and appendicular skeleton. It is supported of course by the activities of the food habitus and is controlled by the nervous system. It subserves the needs of the protective, nutritional and reproductive systems.

Among other significant facts regarding the skeleton as a whole are the following: the head is decidedly long in proportion to the size of the thorax, as in insectivores, and in contrast with most ungulates, in which the head is comparatively small. The thorax is relatively small, perhaps because the food is highly nutritious, and especially because a small animal needs relatively far less food than a large one. The locomotor skeleton must therefore be adapted to the support and propulsion of a large head and a relatively light thorax. Accordingly we find that the backbone has the cervical vertebræ quite short, with a very large lumen for the spinal cord, that the dorsal and lumbar and more proximal tail vertebræ are large, as are also the chief muscles of the back.

Limbs and feet. The most conspicuous and easily interpreted parts of the locomotor habitus are usually the extremities. In *Cænolestes* the pes presents a general development similar to that of *Phascogale* in so far as it has a reduced clawless hallux and is rather narrow, with four sub-equal clawed digits. Such a foot is of the sub-cursorial rather than arboreal type, as indicated also in the skeleton of the foot, the astragalus, for instance, being somewhat intermediate between that of the pedimanous marsupials and that of the highly saltatorial forms (Osgood, p. 95). In this connection Osgood notes (p. 60) that "the muscles of the legs and feet in *Cænolestes* are adapted to a terrestrial, almost cursorial life. The leg muscles have short, thick, fleshy parts and very long tendinous extensions, relatively longer even than in such terrestrial

forms as *Phascologale*, and in this respect are perhaps most similar to those of the saltatorial but otherwise generalized Australian polyprotodont *Antechinomys*, the myology of which has not been thoroughly described. The proportion of tendinous to fleshy parts is about as 60 is to 40 and the outline of the leg thus resembles that of a digitigrade animal. It is markedly different from that of *Didelphis*, in which fleshy extensions reach nearly or quite to the carpus and tarsus. Specialization for terrestrial life has proceeded far beyond that in *Peramys*, whose habits are presumably not greatly different from those of *Cœnolestes* but whose musculature is only slightly different from that of *Didelphis*. . . . . There is some reduction of the intrinsic muscles of the feet, especially in the adductorial sets, and the grasping power is distinctly limited." On the other hand we have the opinion of Lönnberg, expressed as follows: "As already known, *Cœnolestes* has arboreal habits. Its feet with their naked, warty soles and the well developed pads must be useful in climbing, but the fore feet undoubtedly exhibit more pronounced adaptations to the arboreal life. The reduction of the claws on the first and fifth finger to nails and the displacement of the latter in direction towards the carpus must be interpreted as such adaptations. Although neither the pollex nor the fifth finger are directly opposable, they are certainly more free in their movements than the corresponding fingers in f. i. *Phascogale* or some other primitive marsupial. They serve therefore without doubt as useful grasping organs, and the fifth finger appears to do so even in a higher degree than the pollex itself, to judge from the fact that it is more powerful and has a better developed pad at its base."

In brief, if *Cœnolestes* can climb trees at all it does so not by means of the primary arboreal habitus of the Didelphidæ and Australian diprotodonts, which have well developed divergent hallux and pollux, but by a secondary arboreal adaptation involving sharply curved claws on the middle three digits of both manus and pes, with strong, deep flexors of the digits and partly divergent pollex and minimus in the manus. On the other hand, it is perhaps more probable that the strong claws on the hands and feet may be used in scratching for insects on the ground. Taken as a whole the limbs and feet resemble those of rats and insectivores, especially in such particulars as the bowing of the tibia upon the fibula, and of the radius on the ulna, with the reduction of free movement in both cases.

Important indications concerning the method of locomotion are afforded by the following data supplied by Osgood: In *Cœnolestes* the

tibia is very long, the femur being only 63.5 per cent as long as the tibia, i.e., nearly as long as in the saltatorial *Macropus giganteus* in which the femur falls to 57 per cent of the length of the tibia. This contrasts with *Perameles nasuta* in which the femur is 94.3 per cent of the length of the tibia, and still more with *Sarcophilus*, *Trichosurus*, *Phascolomys* and *Phascolarctos*, in which the percentage rises rapidly from 100 to 134.

Other indications of cursorial or partly saltatorial modes of locomotion may be found in the large size of the lumbar vertebræ, which have well-developed, forwardly-directed parapophyses, in the length of the tail and large size of the caudal centra and chevrons, in the fact that the ilium is nearly parallel with the sacral portion of the column as in the kangaroos. There is a distinct so-called center of motion located in an anticlinal vertebra, in the posterior dorsal region, as in Dasyuridæ, Macropodidæ and other terrestrial or leaping forms, and in contrast with the primitive arboreal Didelphidæ in which there is practically no anticlinal vertebra.

In brief, the evidence for cursorial and probably in part saltatorial habits seems fairly conclusive, but it is also barely possible that these small and very active animals run up the trunks and branches of trees.

B. Heritage

That *Cænolestes* has been derived eventually from *Didelphis*-like arboreal forms, in accordance with the views of Dollo and Bensley with regard to marsupials as a whole, is evidenced by the occurrence of many primitive marsupial characters in the locomotor apparatus, such as are found in the Didelphidæ in association with arboreal habits. Even the hands and feet retain evidences of ultimate derivation from a *Didelphis*-like prototype. In the pes perhaps the closest resemblances are to be found in *Phascogale*, but although the underlying pattern is similar, a significant difference is seen in the larger size of the volar pads in *Cænolestes*, which is possibly associated with a scratching or scraping action of the feet.

In the postcranial skeleton of *Cænolestes* Osgood (p. 98) notes a number of peculiar or unique characters which perhaps collectively indicate a long separation from other families of marsupials. Even the resemblances to others are distributed in such a way and are accompanied by so many differences that *Cænolestes* cannot easily be made to fit in either with the Polyprotodontia or the Diprotodontia. On the whole, the postcranial skeleton suggests a nearer relationship with

Australian marsupials of both divisions than with the Didelphidæ. There are also certain special resemblances to the Perameliдæ (Osgood, p. 150) which, taken in connection with other evidence, leads Doctor Osgood to place the cænolestids next to that family.

IV. HABITUS AND HERITAGE OF THE REPRODUCTIVE SYSTEM

With regard to the male generative organs of *Cœnolestes* Doctor Osgood states (p. 65) that the most noteworthy features are the extraordinary size of the prostate and Cowper's glands, the very deeply cleft glans penis and the absence or great reduction of the levator penis muscle. The bifid glans penis occurs in both polyprotodonts and diprotodonts, and affords no definite evidence of relationship, and the other features also are difficult to interpret.

From the comparative standpoint the female reproductive organs, Doctor Osgood concludes, are more significant than those of the male. They are distinctly of a diprotodont rather than a polyprotodont type. This is evidenced by the deep median vaginæ and the long lateral vaginæ, and Doctor Osgood concludes that so far as gross examination indicates, parturition may take place by a short cut through a secondarily developed direct median passage, as in *Perameles* and the Macropodidæ.

The accessory reproductive characters of the female also afford some slight evidence of relationship with Australian forms, since there are four mammæ, as in many Australian genera, in contrast with the much higher number (up to twenty-seven) in the Didelphidæ. But the excessively high birth rate may be one of the features to which the Didelphidæ owe their survival, and it may therefore be a specialization in that family. On the whole, in the characters of the reproductive system *Cœnolestes* shows a closer resemblance with Australian than with known Holarctic forms.

In conclusion, although the zoögeographic bearings of these facts have already been carefully considered by Doctor Osgood, it is to be hoped that he and other specially qualified authorities will further develop the true significance of these Australian-like characters in a South American family.

American Museum of Natural History, New York City.

GENERAL NOTES

ANOTHER OPOSSUM TAKEN IN VERMONT

In the May, 1921, issue of the Journal of Mammalogy the writer recorded the taking of an opossum at East Dorset, Vermont, the previous December. Another of the animals, a large male, was captured in a fox trap late in October, 1921, at Mount Horrid in Rochester, Vermont, by Dexter W. Kathan of Putney, Vermont. The second animal was taken about 45 miles north of the scene of the first capture. Both opossums had withstood considerable cold weather and snow. How they got into northern New England is an unsolved mystery, as inquiry in many sources has failed to disclose any one who has had them in captivity.—GEORGE L. KIRK, *Rutland, Vermont.*

SOME HABITS OF THE PRAIRIE MOLE, SCALOPUS AQUATICUS MACHRINUS

The prairie mole (*Scalopus aquaticus machrinus*) is not uncommon along the Mississippi and lower Wisconsin Rivers in southwestern Wisconsin, where it particularly favors the more sandy bottomlands above high water. At a place known as White City Resort, which lies about 1½ miles north of the Illinois-Wisconsin boundary, and almost directly across the Mississippi from the most northerly parts of the city of Dubuque, Iowa, one was trapped in a Nash mole-trap the evening of August 5, 1920. Only a portion of the skin of the flank of the mole was caught in the trap, so the animal was practically uninjured, and I was able to keep him alive and make a few observations on his habits until the next morning, when it became necessary to prepare him for preservation in the U. S. Biological Survey Collection.

The mole exhibited all the strength accredited to his tribe. The cover of my heavy field telescope weighed probably 10 pounds, yet he easily moved it with his powerful fore legs when crowding between it and the wall. His efforts were always to dig down, or follow along the edge of a board, or under some object. Contact over his entire back seemed in a measure to answer the purpose of his runway, but contact on only a small part of his back acted as an irritant. I laid a mattress on the floor and he took particular delight in "digging under" it. He would raise the mattress and crawl its entire length; and under this mattress was his favorite resting place. I put him in a sink and he seemed particularly attracted to the drain holes, placing his nose first in one little circular opening, then in another, and at times resting for 15 or 20 minutes with his nose in one of the little holes in the drain-pipe sieve. His method of defense was mostly by pushing away the offender with his powerful fore feet, and, in his efforts to accomplish this, he would frequently follow the point of attack around over his back, and roll entirely over. He would, of course, use his teeth occasionally, but not persistently. He did not care for raisins, bat flesh, or cucumber rind, but ate a few cracker crumbs, and especially relished uncooked rolled oats, of which he ate what seemed a prodigious amount for such a small mammal. While he was eating, his proboscis-like nose came into play, it being used to locate each grain of oatmeal and to draw the food into the mouth, not unlike the way an elephant would use its trunk.—HARTLEY H. T. JACKSON, *U. S. Biological Survey, Washington, D. C.*

A BAT NEW FOR CALIFORNIA

Through the courtesy of H. E. Wilder, two specimens of *Corynorhinus rafinesquii townsendii* (Cooper) have come into my possession. They are Nos. FX 18 and GX 54 of my collection. Both are males, the first taken April 14, 1918, and the second taken August 3, 1919, at Carlotta, Humboldt County, California, by Mr. Wilder. Dr. Joseph Grinnell, of the Museum of Vertebrate Zoology, has been good enough to examine these specimens and concurs in the subspecific determination. This form has not, I believe, been hitherto detected within the confines of California.—DONALD R. DICKEY, *Pasadena, California.*

A CORRECTION

In the November issue of this magazine (Journ. Mamm., vol. 2, p. 234) I referred a mongoose from Kentucky to *Herpestes griseus* E. Geoffroy. In doing so I had compared the Kentucky animal with specimens from the West Indies previously identified as *griseus*. Dr. Glover M. Allen has very kindly called to my attention that the mongoose now so common in certain of the West Indies is not *H. griseus*, but *H. birmanicus*. More careful examination of the specimens from the West Indies used as the comparative material shows that they are *birmanicus*. The mongoose from Kentucky should therefore be referred to *Herpestes birmanicus* Thomas.—HARTLEY H. T. JACKSON, *Biological Survey: Washington, D. C.*

A BROWN RAT KILLS A RATTLER

The following observation on *Rattus norvegicus* was made by two friends of the writer, Messrs. Martin and Otting, at their camp on the Colorado River above Austin, Texas, July 15, 1921, and would seem to deserve record in this Journal.

In the middle of the hot afternoon the rat was seen in the short, dry grass some twenty feet from the tent. Instead of scampering for cover as usual at the slightest sound emanating from human presence, the rat engaged in peculiar antics which attracted further attention. Closer inspection disclosed the fact that a mortal combat was in progress between the rat and a two-foot rattlesnake. Curiously enough, a second rat sat nearby so intent upon the rattler that it, too, was entirely oblivious of extraneous noises.

When first seen the serpent had already received two wounds some eight or ten inches from the tip of the tail, apparently through the backbone, for the caudal extremity was paralyzed. The rattler struck repeatedly at the rat, sometimes missing because of the agility of the latter, sometimes knocking it over on its side, but never closing upon it with its fangs. Occasionally the rat would leap over the snake's head and inflict skin wounds upon its antagonist. Finally, after about ten minutes of this give-and-take fight, in which the rat panted tremendously in the broiling sun, the rattler drooped its head for a moment as if to rest; whereupon the rat leaped upon the snake like a flash and won the battle by a single gash of its sharp incisors into its head, the snake wilting instantly. The rat was then dispatched with a shotgun. The snake was a diamond rattler (*Crotalus atrox*) and had two rattles and a "button."

A similar incident was related by Mr. Chas. H. Hamby concerning the prairie brush rat (doubtless *Neotoma*) which gathers large mounds of sticks, grass, dry cow-dung and the like for its nest. Sometimes possession of the nest is successfully disputed by rattlesnakes, which formerly infested the Driscoll Ranch (now in cultivation) 25 miles southeast of Austin, where the observation was made. Mr. Hamby describes the rat as the chief aggressor in the battle witnessed by him. The snake never struck, but confined its activities chiefly to attempts at escaping. It would coil up while the rat would stalk round and round until a favorable opportunity presented itself when the rat would pounce upon the coiled mass and bite furiously. Thereupon the snake would attempt to escape only to coil up again for defense. This procedure was repeated until the snake collapsed; and even after this the rat bit the snake a dozen times before leaving the field of battle. During the fight both snake and rat seemed perfectly oblivious of the observer's presence.

Doubtless the ferocity of the brown rat is a character which makes for its survival and spread, as contrasted with its competitors. Perhaps it is the attenuation of this character in the albino which renders this form impossible to feralize, as five unsuccessful attempts by Donaldson (Wistar Institute) have shown.[1]—Carl Hartman, *The University of Texas, Austin, Texas.*

WOODLAND JUMPING MOUSE NEAR TUXEDO, NEW YORK

On the morning of September 4, 1920, at the boy scout camp in the Interstate Park, some six miles east of Tuxedo, New York, I found in a mouse trap set the evening before an adult male of *Napæozapus insignis*. This particular trap had been placed in some low woods near a small burrow opening beneath a clump of bushes, and the wire loop had struck the mouse only at the base of the tail. The night had been cool; and this had doubtless a marked effect upon the behavior of the jumping mouse, for the trap had been dragged only four feet. Its victim when found was in the sleepy condition of hibernation, showing the result of the lowered temperature even at this early date, for it became active again when warmed.

The only previous records of this species of which I am aware, anywhere in the vicinity of New York City, are those of Mr. Rhoads at Lake Hopatcong, New Jersey,[2] and of Doctor Mearns in the Catskill Mountains, New York.[3] According to Mr. Rhoads this jumping mouse is found in both Pennsylvania and New Jersey in parts of the upper transition zone where no "boreal islands" exist, and certainly the spot where the present example was captured had no particularly boreal aspect.—James P. Chapin, *American Museum of Natural History, New York.*

---

[1] Unpublished data, in addition to the following: Donaldson, Henry H., 1916, "Experiment on the feralization of the albino rat;" Carnegie Yearbook No. 15 of the Carnegie Inst., pp. 200-201.

[2] S. N. Rhoads, Proc. Acad. Nat. Sci. Philadelphia, 1897, p. 29; Mammals of Pennsylvania and New Jersey, 1903, p. 112.

[3] Dr. E. A. Mearns, Proc. U. S. Nat. Mus., vol. 21, 1898, p. 348.

WANTED—DATA ON THE RED SQUIRREL

I am getting together material for a monograph on the red squirrel and I should be grateful for any data on this species. Any accurate information, no matter how fragmentary, will be welcome. I should be particularly glad of notes on family life. First-hand accounts, with all details, of destruction of birds or eggs by this species are desirable, and equally desirable are data on cases where red squirrels have *not* molested nests when the opportunity offered. References to literature which the reader believes to be relatively inaccessible will be appreciated, verbatim quotations, with exact citation of publication, preferred. It is perhaps hardly necessary to state that full credit will be given for all information used.—A. Brooker Klugh, *Queen's University, Kingston, Canada.*

THE CORRECT NAME OF THE WEST AFRICAN PYGMY SQUIRREL

Du Chaillu was the discoverer of the West African pygmy squirrel and has also been credited with its original description as *Sciurus minutus* (Proc. Boston Soc. Nat. Hist., VII, 1860, p. 366). Later Major (Proc. Zool. Soc. London, 1893, pp. 181, 187, 189 and 215) included it among his Nannosciurinæ, but without separating it generically from the East Indian or South American representatives of that subfamily. It remained thus *Nannosciurus minutus* (Du Chaillu) until Thomas (Ann. Mag. Nat. Hist., (8) III, 1909, pp. 469, 474 and 475) created a new genus *Myosciurus* for the West African form, with *Sciurus minutus* Du Chaillu as type by monotypy. Hollis'er (Proc. Biol. Soc. Washington, XXXIV, 1921, p. 135) changed this name to *Myosciurus minutulus* on the ground that Du Chaillu's name was preoccupied by *Sciurus minutus* Lartet, a fossil species.

Accepting Hollister's revision as correct, I later happened to compare Leconte's descriptions of mammals from the Du Chaillu collection. I came to the conclusion that Leconte's *Sciurus pumilio* fitted the West African pygmy squirrel and could in no way be identical with, as Trouessart supposed, his *S. subviridescens* (= *Æthosciurus poensis*). Hollister, to whom I communicated my findings, asked me then to prepare this note for publication.

Witmer Stone of the Academy of Natural Sciences of Philadelphia kindly informed me that though they have a number of mammals collected by Du Chaillu, there is no specimen positively identifiable as Leconte's *Sciurus pumilio*. Glover M. Allen, who is sure that the type of *Sciurus minutus* Du Chaillu is not in the Cambridge Museum, supposes that Du Chaillu went first to Philadelphia and left his specimens with Leconte, who then was the first to describe *Sciurus pumilio* (Proc. Ac. Nat. Sci. Philadelphia, IX, 1857, p. 11). Three years later, as stated above, Du Chaillu's own description appeared without any mention of Leconte's previous work.

Trouessart seems to be responsible for the confusion. In his first catalogue and in subsequent references he places *pumilio* in the subgenus *Heliosciurus: Sciurus* (*Heliosciurus*) *pumilio* (Bull. Soc. Et. Sci. Angers, X, 1, 1880, p. 84; Le Naturaliste, I, no. 37, 1880, p. 292; *op. cit.*, no. 40, 1880, p. 315; Bull. U. S. Geol. Geogr. Surv. Terr., IV, no. 2, 1881, p. 306). He finally disposes of *pumilio* in his second catalogue (Cat. Mamm. Viv. Foss., 1897, p. 406) as a synonym of *Xerus* (*Paraxerus*) *poensis*, connecting "*pumilio et subviridescens.*" From then on *pumilio* disappears from the literature.

Considering the above facts I can see no reason why *pumilio* should not stand and why *Myosciurus pumilio* (Leconte) has not priority over other names. *Myosciurus minutus* (Du Chaillu) and *Myosciurus minutulus* Hollister should be considered synonyms.—HERBERT LANG, *American Museum of Natural History, New York.*

MAGPIE AS SENTINEL FOR RABBITS

The following note sent me by Capt. Henry Savile of Cheltenham, England, shows that the magpie serves the British rabbits much as our bluejay does several American fourfoots.

"I saw rather an interesting little thing the other day, showing that wild animals do communicate with each other. In the center of a large field was a rabbit warren. One evening, while dressing for dinner, I saw a black stable cat stalking the bunnies. Just before it got within springing distance, and as it was lashing its tail from side to side, from a small coppice, out flew two magpies, gave a cry and every rabbit disappeared. I saw this six nights running, and my host told me it had been the same every night for some time."—ERNEST THOMPSON SETON, *Greenwich, Conn.*

DEATH OF CHARLES B. CORY

Charles Barney Cory, well known as one of the most prominent of American ornithologists, died in Ashland, Wisconsin, July 31, 1921. Although chiefly devoted to the study of birds, he had given considerable time to mammals and, especially by the production of his book on the "Mammals of Illinois and Wisconsin," had placed all mammalogists in his debt.

He was born in Boston, January 31, 1857, and was descended from old New England stock. His interest in natural history began in his teens and before he was twenty he had formed a considerable collection of birds. For many years he was possessed of an ample fortune which permitted him to follow his naturalist's bent without let or hindrance. A large share of his attention in earlier life was given to Florida and the West Indies. His collections from these regions, although mainly ornithological, included many mammals, quite a number of which are still preserved in the Field Museum. He was the first to call attention to the differentiation of the Florida cougar to which he gave the name *Felis floridana*. This name being preoccupied, it was renamed in his honor, *Felis coryi*.

For the last fifteen years of his life, after having suffered the loss of his fortune, he held the responsible position of curator of zoology in the Field Museum of Natural History of Chicago. Here he labored most assiduously in the study of birds and, after considerable other work, engaged in the preparation of a series of volumes under the title "Birds of the Americas," only two parts of which had appeared at the time of his death. Among his earlier books were many known to naturalists the world over, as "Birds of the Bahamas," "Beautiful and Curious Birds of the World," "Birds of Haiti and San Domingo," "Birds of the West Indies," "Birds of Illinois and Wisconsin," "Hunting and Fishing in Florida," and "Naturalist in the Magdalen Islands."

He was a man of jovial disposition, fond of a good story, fond of music, fond of games of all kinds and interested in many things besides natural history. As a young man he gave much time to outdoor sports and in middle life he became passionately devoted to the game of golf in which he attained exceptional skill. Throughout a varied and active life, his love for animals, especially birds, was maintained to the end.—W. H. OSGOOD, *Chicago, Ill.*

RECENT LITERATURE

Bresslau, Ernst. THE MAMMARY APPARATUS OF THE MAMMALIA IN THE LIGHT OF ONTOGENESIS AND PHYLOGENESIS. WITH A NOTE BY J. P. HILL. London: Methuen & Co. Pp. i–vii, 1–145, with 47 illustrations. 1920.

This splendid book is a résumé of the author's extensive investigations on the development of the milk-glands and related structures in mammals and on the evolutionary history of the mammary apparatus. The subject is divided into three chapters describing the development of the mammary organs in the three principal groups of mammals, Monotremata, Marsupialia, and Placentalia.

The development of the mammary apparatus does not begin with the arrangements for the accomodation of the young, i.e. with the formation of the pouch, but much earlier, with structures which the author terms primary-primordia, that is, gland areas. These are followed in *Echidna* by the development of the incubatorium and at last by mammary glands. The gland areas act as a hindrance to the extension of the developing panniculus carnosus muscle immediately after birth. Thus there remains an oval, muscle-free area on the ventral side of the trunk which later develops into the incubatorium. In *Ornithorhynchus* the incubatorium is absent, most likely an adaptive feature in this aquatic animal. The marsupium or pouch in marsupials is in no way to be compared with the incubatorium of *Echidna*. It arises as the result of developmental processes in the epidermis which lead to the formation of so-called marsupial pockets, which are entirely unrepresented in *Echidna*. The great apparent similarity of incubatorium and marsupium in the adult animals rests solely on convergence. Among the Didelphyidæ there are many pouchless forms in which a marsupium never existed. No pouch rudiments can be found in the Placentalia, since a pouch stage is not included in the phylogenesis of this group.

The original nipple is represented by the simple type of eversion nipple which forms the common point of departure for the evolution of the marsupial as well as of the placental nipples. This type arises from the nipple pouches, discovered by Morgan, the final nipple appearing through eversion of the pouch. Another type, the so-called proliferation nipple, is formed through the involution of the nipple pouch stage. Here the nipple wall is formed essentially by the cutis, the apical portion only by the original primordia; whereas in the first mentioned type of nipple almost the entire epithelial covering is furnished by the original primordia. The so-called milk-streaks of placental embryos are homologous to the primary-primordia of monotremes and marsupials. From these milk-streaks spring the nipples and milk-glands of the Placentalia and their development is much like that in marsupials.

The interesting discussions on the number and arrangement of nipples in marsupials, on the specializations of this organ in placentals, on the mammary hairs, and other related questions do not lend themselves for further condensation in this review. It is to be regretted that some of the illustrations are not better reproduced.

—*A. H. Schultz.*

Michelsson, G. DIE HAUTMUSKULATUR DES IGELS (ERINACEUS EUROPAEUS). Morphol. Jahrb., vol. 51, pp. 147–229. 1921.

A careful, detailed description of the cutaneous musculature of the hedgehog, *Erinaceus europæus*, and a comparison of these muscles with related structures in

other mammals. Thirty-five specimens of the hedgehog were dissected and some interesting variations in the cutaneous musculature were found. The author concludes that the facial musculature in particular represents a mixture of primitive conditions, resembling those found in *Echidna*, and those existing in much higher forms. The large orbicularis muscle is restricted to the hedgehog, but seems to have developed from the musculus humero-dorsalis, which has a very wide distribution among mammals. All the facial and cervical musculature is supplied from the nervus facialis, and all the trunk musculature, except the musculus dorso-cuticularis, from the anterior thoracic nerve.

—*A. H. Schultz.*

Ackerknecht, Eberhardt. Über den Begriff und das Vorkommen der Spatien im Säugetierkörper. Anat. Anz., vol. 54, pp. 465–490. November 30, 1921.

Andrews, C. W. Note on a bear (Ursus savini, sp. n.) from the Cromer Forest-bed. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 204–207. February, 1922.

Anthony, H. E. From humid forest to snow-capped height in Ecuador. Nat. Hist., vol. 21, pp. 459–473; 13 figs. September-October, 1921. (Contains many notes on mammals.)

———Mammals collected by William Beebe at the British Guiana Tropical Research Station. Zoologica, vol. 3, no. 13, pp. 265–285; 2 pls. December 24, 1921. (Lists 56 species from the station, and 4 additional forms from Georgetown. An appendix by Beebe lists species seen but not collected and preserved, and brings the total number at the station to 70.)

Baker, Frank Collins. The importance of ecology in the interpretation of fossil faunas. Ecology, vol. 2, pp. 277–280. October, 1921 (January, 20, 1922).

Baker, F. S., C. F. Korstian, and N. J. Fetherolf. Snowshoe rabbits and conifers in the Wasatch Mountains of Utah. Ecology, vol. 2, pp. 304–310. October, 1921 (January 20, 1922).

Blaine, Gilbert. Three new races of Cephalophus monticola. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 174–176. February, 1922. (New subspecies from Rhodesia and Zululand.)

Chapman, Frank M. A life of abundant accomplishment. Nat. Hist., vol. 21, pp. 515–519. September-October, 1921. (Sketch of the life and work of Dr. J. A. Allen, 1838–1921.)

Evermann, Barton Warren. Fur seals off the Farallones. Science, n. s., vol. 54, pp. 547–548. December 2, 1921.

Fernandez, Miguel. Schuppe, Haar und Haarscheibe der Säugetiere. Anat. Anz., vol. 54, pp. 506–526, 1 pl. December 12, 1921.

Flower, S. S. Report on the Zoological Service for the year 1920 in which is included the 22nd annual report of the Giza Zoological Gardens. Ministry of Public Works, Egypt, Zool. Service, Pub. no. 34, pp. 1–20. Cairo, 1921. (On October 6, 1920, the Giza gardens contained 328 mammals of 87 forms.)

Grinnell, Joseph. Two new rodents (genera Thomomys and Marmota) from the eastern border of California. Univ. California Pub. Zool., vol. 21, pp. 239–244, 6 figs. November 7, 1921. (Describes *Thomomys perpallidus amargosae*, Shoshone, Inyo County, California; and *Marmota flaviventris fortirostris*, White Mountains, Mono County, California.)

GRINNELL, JOSEPH, AND TRACY IRWIN STORER. Some mammals of Yosemite National Park. Hall's Handbook of Yosemite National Park, G. P. Putnam's Sons, pp. 155–173, 4 pls. 1921.

GROTE, HERMANN. Neue Erdferkel (Orycteropus) aus Deutsch-Ostafrika und Kamerun. Archiv f. Nat., 87 Jahrg., Abt. A, Heft 7, pp. 121–127. 1921. (Describes five new subspecies of *Orycteropus afer*.)

HAAGNER, A. K. A guide to the National Zoological Gardens of South Africa. Pp. 1–54, many illustr. Pretoria. October, 1921.

HAY, OLIVER P. Descriptions of some Pleistocene vertebrates found in the United States. Proc. U. S. Nat. Mus., vol. 58, pp. 83–146, pls. 3–11. October 12, 1920.

HIRSCH, MAX. Der Lückzahn von Sus domesticus, ein Beitrag zur Entwicklungsgeschichte des Gebisses von Sus domesticus und zur Kenntnis des Wesens der Dentitionen. Anat. Anz., vol. 54, pp. 323–330. October, 1921.

HOLLISTER, N. Report of the superintendent of the National Zoological Park for the fiscal year ending June 30, 1921. Ann. Rep. Smithsonian Inst., 1921, pp. 84–99. December, 1921.

INTERNATIONAL COMMISSION ON ZOOLOGICAL NOMENCLATURE. Opinions rendered by the International Commission on Zoological Nomenclature. Opinions 68 to 77. Smithsonian Misc. Coll., vol. 73, no. 1, pp. 1–73. January 31, 1922.

JACOBSON, E. Notes on some mammals from Sumatra. Journ. Fed. Malay States Mus., vol. 10, pt. 3, pp. 235–240. 1921. (Interesting notes on the hare, tiger, leopard, and other species.)

JENKINS, J. TRAVIS. A history of the whale fisheries. Pp. 1–336, 12 pls. London: H. F. and G. Witherby. 1921.

KHALIL, M. A preliminary note on some new nematode parasites from the elephant. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 212–216. February, 1922.

KLOSS, C. BODEN. Seven new Malaysian mammals. Journ. Fed. Malay States Mus., vol. 10, pt. 3, pp. 229–234. 1921. (New forms of *Balionycteris*, *Petaurista*, *Sciurus*, *Lariscus*, and *Rattus*.)

KLUGH, A. BROOKER. A correction concerning the life zones of Canada. Biol. Bull., vol. 41, pp. 272–275. November, 1921 (January, 1922). (Extends Transition Zone northward in Ontario to mouth of Shawanaga River, including Bruce Peninsula therein.)

KRIEG, HANS. Über Pigmentzentren bei Säugetieren. Anat. Anz., vol. 54, pp. 353–365. October 15, 1921.

MERRIAM, C. HART. A California elk drive. Sci. Monthly, pp. 466–475. November, 1921.

MERRIAM, JOHN C., AND CHESTER STOCK. Occurrence of Pleistocene vertebrates in an asphalt deposit near McKittrick, California. Science, n. s., vol. 54, pp. 566–567. December 9, 1921.

MOULTON, J. C. Occurrence of the Malayan badger or teledu in Borneo. Journ. Straits Branch, Royal Asiatic Soc., no. 83, pp. 142–146. April, 1921. (New: *Mydaus javanensis montanus* from northern Sarawak, Borneo.)

NELSON, E. W. Report of chief of Bureau of Biological Survey. Washington. Pp. 1–34. 1921.

NIELSEN, AAGE KRARUP. En Hvalfangerfærd gennem Troperne til Sydishavet. Copenhagen: H. Aschehoug & Co. 160 pp. 1921. (A profusely illustrated account of a voyage from Norway to the whaling grounds in the South Shetland Islands.)

OBERHOLSER, HARRY C. Notes on Horsfield's "Zoological Researches in Java." Proc. Biol. Soc. Washington, vol. 34, pp. 163–166. December 21, 1921.

OSBORN, HENRY FAIRFIELD. Joel Asaph Allen, 1838–1921. An appreciation. Nat. Hist., vol. 21, pp. 513–515, portrait. September-October, 1921.

——— The evolution, phylogeny, and classification of the Mastodontoidea. Bull. Geol. Soc. Amer., vol. 32, pp. 327–332. September 1 (October 5), 1921.

——— Adaptive radiation and classification of the Proboscidea. Proc. Nat. Acad. Sci., vol. 7, no. 8, pp. 231–234. August (December 19), 1921.

ROBINSON, HERBERT C., AND C. BODEN KLOSS. New mammals from French Indo-China and Siam. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 87–99. January, 1922. (Describes new forms of *Tupaia*, *Crocidura*, *Ratufa*, *Callosciurus*, *Tamiops*, *Rattus*, and *Tautalus*.)

SCHULTZ, ADOLPH H. Fetuses of the Guiana howling monkey. Zoologica, vol. 3, no. 12, pp. 243–262, 6 figs. December 24, 1921.

SCHUMACHER, SIEGMUND. Darmzotten und Darmdrüsen bei den Waldhühnern. Anat. Anz., vol. 54, pp. 373–381. October, 1921.

SHAW, WILLIAM T. Moisture and altitude as factors in determining the seasonal activities of the Townsend ground squirrel in Washington. Ecology, vol. 2, pp. 189–192. July, 1921.

SHUFELDT, R. W. Skeletons of the monotremes in the collection of the Army Medical Museum at Washington. Royal Soc. Tasmania, Papers and Proc., 1921, pp. 99–110, 5 pls. October 28, 1921. (Describes skeletons of *Ornithorhynchus* and *Echidna*.)

——— How skunks defend themselves. Amer. Forestry., vol. 28, pp. 26–29, 41, 10 figs. January, 1922. (Popular account of North American Mustelidæ.)

——— Badgers and wolverenes. Amer. Forestry, vol. 28, pp. 105–112, 8 figs. February, 1922. (Popular account of the American forms.)

SUMNER, F. B. The responsibility of the biologist in the matter of preserving natural conditions. Science, n. s., vol. 54, pp. 39–43. July 15, 1921.

THOMAS, OLDFIELD. On a further collection of mammals from Jujuy obtained by Sr. E. Budin. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 608–617. December, 1921. (New forms: *Sciurus argentinius*, *Phyllotis nogalaris*, *Neotomys vulturnus*, *Hypsimys deceptor*, and *Oxymycterus akodontius*.)

——— The masked civets (Paguma) of western China. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 617–618. December, 1921. (New: *Paguma larvata yunalis* and *P. l. rivalis*.)

——— On three new Australian rats. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 618–622. December, 1921. (New: *Leporillus jonesi*, *Rattus villosissimus profusus*, and *Pseudomys australis oralis*.)

——— New Hesperomys and Galea from Bolivia. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 622–624. December, 1921.

——— Two new species of slow-loris. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 627–628. December, 1921. (Describes two new species of *Nycticebus*.)

THOMAS, OLDFIELD. On some interesting hedgehogs from the Persian Gulf. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 142–144. January, 1922. (Three new forms of *Paraechinus*.)

——— On some new forms of Ochotona. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 187–193. February, 1922. (Describes 6 new species and subspecies from central Asia.)

——— Some notes on ferret-badgers. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 193–196. February, 1922. (New forms of *Melogale* and *Helictis*.)

——— On the systematic arrangement of the marmosets. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 196–199. February, 1922. (One new species: *Mico leucippe* from lower Amazon.)

THOMAS, OLDFIELD, AND MARTIN A. C. HINTON. The Mammals of the 1921 Mount Everest Expedition. Ann. and Mag. Nat. Hist., ser. 9, vol. 9, pp. 178–186. February, 1922. (Pikas were seen at an altitude of 20,100 feet. New species of *Cricetulus*, *Phaiomys*, and *Ochotona*.)

TROUESSART, E.-L. La Distribution Géographique des Animaux. Pp. 1–332; i–xii; 14 figs., maps. Gaston Doin, Paris, 12fr. 1922. (A volume of the Encyclopédie Scientifique, Bibliotheque de Zoologie.)

WALKER, ALEX. Some notes on the preparation of mammal skins. Oologist, vol. 38, pp. 166–170. December, 1921.

ZUKOWSKY, LUDWIG. Mitteilungen über eine anscheinend neue Form von Hylochoerus aus dem Winterhochlande, vom Mutjekgebirge und vom Meru-Berge. Archiv f. Nat., 87 Jahrg., Abt. A, Heft 1, pp. 179–191; 1 fig. July, 1921. (*Hylochoerus schulzi*, sp. nov.)

——— Wissenschaftliche Bemerkungen über das Wild des Kaokofeldes unter Berücksichtigung der Aufzeichnungen und der Sammlung des Herrn Hauptmann a. D. Steinhardt. Reprint from Steinhardt's "Vom wehrhaften Riesen und seinem Reiche," ed. 2; separates paged 1–15. October 1, 1921. (New species: *Opsiceros occidentalis*.)

CORRESPONDENCE

THE ZOOLOGICAL RECORD

The Editor, Journal of Mammalogy:

I should be glad if you would draw the attention of your readers to the present position of the Zoological Record.

Owing to the collapse of the International Catalogue of Scientific Literature, in connection with which the Record was published from 1906 to 1914, the Zoological Society of London has undertaken to bear the whole financial responsibility for the preparation and printing of the Record.

Owing to the great increase of the cost of printing and to the very meagre support accorded to the Record by zoologists and zoological institutes generally, the financial burden of this undertaking on the Zoological Society is becoming very severe. The cost of printing the Record now amounts to between £1500 and £2000 annually and the Society receives back by subscribers and sales less than 25 per cent of this sum; I fear, therefore, unless zoologists are prepared to make greater efforts to support the undertaking, there is a strong possibility that the Council of the Zoological Society may refuse to find this large sum each year.

It appears, therefore, to be the duty of every zoologist to help so far as he is able to support this most invaluable work. All particulars and forms of subscription can be obtained from the Secretary of the Zoological Society, Regents Park, London N. W. 8., but I may mention that the price of the whole volume is now £2. 10. 0. and the price of the separate parts a proportional smaller sum.

Yours faithfully,
W. L. Sclater.

London, 1 February, 1922.

FOURTH ANNUAL MEETING IN NEW YORK

The Fourth Annual Meeting of the American Society of Mammalogists will convene in New York City, May 16–18, 1922. Sessions devoted to the reading of papers, discussion, and business, will be held from 10:00 A. M. to 4:30 P.M., May 16–17, in the American Museum of Natural History. There will be an evening session with motion pictures, May 17. Members of the Society will have an opportunity on May 18 to visit the new Heads and Horns Building and other places of interest in the New York Zoological Park as guests of the New York Zoological Society. The whole meeting promises to be exceptionally interesting and important. The Committee on Arrangements consists of Mr. H. E. Anthony, chairman; Mr. Herbert Lang; Dr. Robert Cushman Murphy; and the Corresponding Secretary, ex-officio. Hotel headquarters will be at the Hotel Majestic, 72nd Street and Central Park West, five blocks south of the American Museum.